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Host and Server Determination of Alcohol Intoxication Level

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16. Abstract

An Impairment Estimation Procedure (IEP) was developed from a set of alcohol impairment cues found to be associated with measured blood alcohol concentrations. Some 24 cues representing social behavior, physical appearance, and motor coordination, obtained by observing 149 drinkers in social situations, were divided into two categories: those corresponding to moderate impairment (BAC .04-.08) and those corresponding to severe impairment (BAC >.08). Observers using the IEP estimated impairment more accurately than those not using it when impairment was manifest in both breath tests and field sobriety measures. The superiority of the IEP-guided observers was greatest in identifying moderately impaired drinkers, particularly those considered not impaired by unguided observers.

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Background

While most people have some sort of system for judging the alcohol impairment of others, their accuracy is questionable. Langenbucher and Nathan (1983) showed only police officers to be accurate in inferring BAC levels from behavioral signs of impairment. However, other research has shown even law enforcement officers to be far from accurate in assessing impairment (Taubenslag and Taubenslag 1975, Pagano and Taylor 1980, Vingilis 1983, Compton 1985).

Most of the research into accuracy of BAC estimation has left the procedure up to those doing the estimating. Teplin and Lutz (1985), however, trained groups of observers in the use of specific cues. While their overall results were promising--a correlation of .84 between estimated and actual BAC, the drinkers who constituted the objects of the estimation process represented an extreme range of impairment, from 0 BAC (three quarters of the sample) to BACs in excess of .15. Distinctions over this range are generally not hard to make. Much more difficult is distinguishing those who are not quite impaired enough to be dangerous from those who might have just crossed over the line. Yet, this is the critical distinction that police, waiters and waitresses, and social hosts must be able to make.

The goal of the project described in this report was to identify a set of visible impairment cues that could be used to generate accurate estimates of blood alcohol level. Attainment of this goal was sought through a three step process of (1) identifying a candidate set of impairment cues, (2) assessing the candidates cues for their relationship to the impairment, (3) validation of an impairment estimation procedure based upon cues.

Identification of Impairment Cues

A list of candidate cues was compiled from the scientific and technical literature and from the results of observations carried out in bars and restaurants under a previous project. Focus group discussions were also held but did not add to the list.

The initial list of cues was screened by a panel engaged in research with alcohol-dosed subjects. The 166 cues that the panel agreed were valid indicators of impairment were combined into 60 basic cue categories.

Assessment of Cues

Each of the cues identified through the sources described was assessed for its relationship to blood alcohol through observations of drinkers in a social setting. Some 149 volunteer subjects participated in seven events in which they were free to drink as much as they wished, up to a BAC limit of .12. Subjects were called upon to submit to a breath test after every two drinks.

Observers trained in the use of the cues watched the subjects and noted the appearance of cues, recording both the time the cue appeared and the code number of the subject. Each observer was responsible for monitoring five subjects at a time. While the subjects were aware that they were being observed, they were told the purpose of the event was to provide a check on the accuracy of different alcohol breath measurement devices.

Of the original list of cues, 34 were found to merit inclusion in an impairment detection procedure. Use of the cues yielded a hit-rate that was 8% better than chance when estimating impairment when BAC was in four categories and 15% better than chance when estimating impairment in three categories. Estimates of BAC correlated .48 with measured BAC. A multiple regression equation including estimated BAC, history of overdrinking, drinker age, and the number of cues observed achieved a multiple R of .56. The correlation was not raised by addition to the equation of the drinkers' sex, weight, frequency of drinking, amount typically consumed, or frequency of overdrinking.

Evaluation of Impairment Estimation Procedure

An Impairment Estimation Procedure was devised to enable observers to distinguish, from observed cues, three levels of impairment: slight (BAC .00-.04), moderate (BAC .04-08), and severe (BAC >.08). The primary objective of the Impairment Estimation Procedure was to distinguish moderate from severe impairment. Cues associated with slight impairment were not included in the estimation procedure. The list of cues was also reduced from 34 to a more manageable 24 by combining similar cues.

The observers were selected so as to be representative of the types of people who would be expected to employ the estimation procedure in a social situation. A total of 16 observers were evenly divided by guidance (with and without the estimation procedure), role (social hosts versus professional server), continuity (observed same drinkers continuously versus change periodically), and gender of observer. Those in the "guided" group were given a briefing and a handout describing the impairment estimation procedure.

The experimental procedure was similar to that employed in the cue assessment, with guests being allowed to drink at will and breathtests being administered after every two drinks. To help account for differences in tolerance, the breathtests were accompanied by administration of a gaze nystagmus and a one-leg stand sobriety test. Instead of simply reporting cues, observers estimated the impairment level of their five assigned drinkers every half hour.

Analysis of results from the Impairment Estimation Procedure showed that all subjects did better than chance in estimating impairment level and that those guided by the procedure were more accurate than those who were not so guided. With only eight observers per group, however, the differences were not statistically significant. However, when some control was exercised over the effects of tolerance

by including observations for only those subjects who were classified in the same impairment level by both the breathtest and the two sobriety tests, the differences were statistically significant. The advantage of the Impairment Estimation Procedure was found primarily among the moderately impaired subjects where the improvement over chance manifested by the guided observers was 75% greater than that of the unguided observers. The advantage of guidance was primarily in reducing the number of false negatives (moderately impaired subjects mis-classified as slightly impaired) by 50%. Slightly more accurate estimates of impairment were rendered by the professional servers, males, and those observing the same subjects continuously. However, the differences were relatively small and statistically non-significant.

The Impairment Estimation Procedure was judged to have sufficient value in improving ability to estimate levels of impairment to justify full-field testing by representative social hosts and professional servers under realistic circumstances.

INTRODUCTION

The research literature clearly indicates that even "experts" such as physicians and police have considerable difficulty in determining BAC levels from behavioral signs. Yet the ability to make reasonably accurate estimates of the extent of impairment would seem to be a precondition to the success of contemporary countermeasures which call upon the people to intervene in the drinking and driving of others ("Friends don't let friends drive drunk"). According to NHTSA (1988), at the present time, this exhortation is backed up by law in 29 states holding licensed establishments and their servers liable for damages to third parties resulting from service to intoxicated patrons. In addition, in some eight states, social hosts are similarly liable (these numbers do not include states limiting dram shop or social host liability to instances of service to minors).

BACKGROUND

Most people probably already have rating systems which they apply to their peers in judging level of alcohol impairment. Unfortunately, the research literature indicates that traditional beliefs regarding the signs of intoxication do not provide the accuracy needed to make them a strong basis for countermeasure action.

Studies with Police

The work of Langenbucher and Nathan (1983) showed that, among several categories of people whose work exposed them to intoxicated drinkers, only police officers were at all accurate in inferring BAC levels from behavioral signs of impairment. Alternatively, other studies have indicated that even police are not very accurate in assessing the BAC levels of drinkers with whom they come in contact.

Pagano and Taylor (1980) studied the accuracy of police perceptions of alcohol intoxication in a simulated situation involving an interview with an individual acting the part of a husband in a domestic quarrel. The officer's problem was to determine whether the individual had been drinking. These researchers dosed their actor/accomplices with two levels of alcohol. One dose produced BACs between .037% and .043% and the other between .096% and .097%. The results indicated that police officer estimation of drinking was no better than chance in distinguishing the two groups.

Studies of the accuracy of the police officer's ability to detect drinkers in their normal enforcement duties have tended to indicate that, under operational conditions, they are able to identify only one out of two drinkers who are above .10% BAC. Taubenslag and Taubenslag (1975) reported on a study of Florida motorcycle police in

which an officer persuaded a driver to take a breath test once the officer had completed his investigation of the driver. The officer assured the driver that there would be no further action taken and was able to obtain a test just before the driver drove away. This study indicated that the police officers actually charged only one in four of the .10% drivers with DWI and gave other types of citations to the remaining high BAC drivers.

Vingilis (1983) established a research program to obtain breath tests from motorists who had just passed through an enforcement checkpoint in Toronto, Canada. Officers were checking each driver to determine whether they should be tested for alcohol. The officer was to make a test if he believed that the motorist was at .08% or greater BAC. Under these circumstances, Vingilis found that the officers detected only 1 in 10 of the .08% and higher drivers passing through the checkpoint. Jones and Lund (1985) found that officers conducting a sobriety checkpoint in Charlottesville, Virginia, identified only 48% of the .10% or greater drivers passing through the checkpoint.

Compton (1985) obtained a much higher success rate for identification of drivers at .10% and above in an experiment in which a sobriety checkpoint was simulated and arriving drivers had been previously dosed with known amounts of alcohol. In Compton's experiment, the officers using traditional detection procedures were able to identify 87% of the drivers above .10%. On the other hand, the officers also identified as impaired 87% of the drivers with lower BACs between .05% and .09%, and 47% of the drivers at .00% to .04% BAC. This is a high proportion of false positives.

Role of Training

Despite studies which indicate that even police officers have considerable difficulty in identifying individuals who are at illegal BAC levels, there is evidence that, with adequate training, reasonable discrimination of BAC can be obtained. For example, Compton found that when officers were fully trained on special sobriety tests and recognition systems including nystagmus that they could distinguish 100% of the drivers above .10% while misidentifying as intoxicated only 8% of the drivers between .00% and .04%. More recently, Teplin and Lutz (1985) have demonstrated that trained observers can judge the BAC level of individuals coming into an emergency room with relatively high accuracy. They found a correlation of .84 between their observational scale and the BAC of the subjects.

Particularly significant in the Compton and the Teplin and Lutz studies was that trained investigators were able to identify items of appearance and behavior which would appear to be available to the general public and to hospitality employees as methods of judging intoxication. Compton found that the odor of alcohol, flushed face, slurred speech, dilated eyes, general demeanor, poor dexterity, and disheveled clothes were signs which significantly distinguished between high and low BAC drivers when

observed by the police in his simulated checkpoint operation. Teplin and Lutz included odor of alcohol, loss of fine motor control, impairment of gross motor control, slurred speech, changed speech volume, decreased alertness, sweating, slow respiration, sleepiness, changed pace of speech, and red eyes as items on their BAC rating scale. All of these would appear to be signs which would be available to friends and hospitality personnel who have reason to observe and intervene with those who are drinking too much.

It is possible to distinguish at least two categories of users of cues to intoxication. One group might be called "casual" users and consists of people who are from time to time in the company of drinkers whose level of impairment may be reason for concern, including friends, relatives, and colleagues. The other category might be called "professional" users and are those who are called upon to make judgments of impairment as a part of their job. Examples of the latter are police, bartenders, waiters and waitresses, security people, and alcoholism treatment providers. While the signs of impairment do not differ as a function of who is viewing them, the ability and willingness of the users is likely to. One might expect professional users of information about intoxication cues to be more likely to participate in formal training programs where they might learn the ability to use cues of greater complexity.

Need for Research

The results of the Teplin and Lutz research might appear to be so good as to negate the need for further study. They've demonstrated that, by the use of 11 signs, observers are able to estimate BAC with a correlation of .84. It may seem that all that is necessary is to package this procedure in a form that can be used by the general public and by hospitality employees and the problem of estimating BAC is solved. But there are some troublesome aspects of their results with respect to the applicability of their scale to the normal drinking situation in the home or in public drinking establishments.

The overall .84 correlation obtained by Teplin and Lutz was based on the full range of BACs from .00% to the highest level patient evaluated in the study. Unfortunately, Teplin and Lutz do not provide us with the BAC distribution against which they validated their test. They do note, however, that there was some shrinkage in this correlation when subgroups selected by BAC were evaluated.

While well suited to the clinical setting in which they were developed, the system of impairment estimation offered by Teplin and Lutz is limited in its application to the conditions under which hosts and servers must make judgments. One limitation concerns the *types* of cues upon which the system is based, many of which do not lend themselves to the social or commercial drinking environment. For example, alcohol on the breath, their most predictive cue, may be a sign which is very useful in

distinguishing drinkers from non-drinkers but is likely present for most individuals in a bar or party and therefore has no discriminating value for BAC levels above .00. At the other end of the scale, staggering, abusive language, and other obvious drunken behavior will be of little utility in the desired scale because individuals who demonstrate these signs are already readily identified by the public and intervened upon when the public is motivated to do so.

The second limitation concerns the *levels* of impairment involved. While Teplin and Lutz reported the effect of removing from the subject sample all those with BAC=.00% (506 of 672 had BAC=.00%), they did not similarly exclude the high end of their intoxication scale, (e.g., BAC>.15%) or the very low intoxication levels that cannot be shown to have much impact on judgment or motor behavior. To be useful to hosts and servers, cues must be able to detect impairment between the point at which it begins to effect behavior and the point at which it becomes obvious without the aid of any impairment estimation system. This corresponds roughly to the BAC range of .05-.10%.

Finally, since the impairment system is based on the *number* of cues observed, it does not permit estimation of impairment when only one or two cues are observable. Yet, this may be all that a host or server, dealing with a large group of drinkers, may have an opportunity to witness. Clearly, various cues differ substantially in the degree of impairment they reveal. A drinker who has passed out is likely to be more severely impaired than one who simply manifests a ruddy complexion.

To be of practical use to hosts and servers in detecting impairment among their guests, an impairment estimation procedure had to overcome these limitations. Specifically, it had to be based upon the types of cues that are most likely to be manifest and are most readily observed in social situations under which drinking in homes and bars or restaurants occurs. Second, it had to be capable of discriminating degrees of impairment within the transition zone, that is, between the point at which serious impairment begins to occur and the point at which it becomes obvious to anyone. Finally, it had to permit estimation of impairment on the basis of individual cues rather than requiring the manifestation and observation of large numbers of cues.

OBJECTIVE

The objective of this project was to identify a set of visible impairment cues that could be used to generate accurate estimates of blood alcohol level subject to the following:

- The cues of impairment must be capable of being obtained without requiring the participation or the cooperation of the drinker whose impairment is being judged.

- An impairment estimation procedure employing the cues must be capable of being communicated effectively. The amount of instruction required for their use may vary with category of user, so long as different levels of users are identified.

- Within the various levels of impairment represented by cues, the procedures must be able to distinguish those individuals meeting the legal definition of intoxication.

GENERAL APPROACH

The development of procedures for detecting various levels of impairment involved the following three phases:

Identification of cues -- An identification of candidate impairment cues through survey of the literature, focus group discussions, and ratings by research professionals in a position to relate behavior to known BAC levels.

Assessment of cues -- A determinant of the relationship between the occurrence of candidate cues and measured BAC level in a series of social drinking events.

Validation of procedure -- Validation of an impairment estimation procedure through its application by observers at drinking events and measurement of actual BACs.

Each of these efforts make up a major section of this report.

IDENTIFICATION OF CUES

The identification of cues involved two processes:

- Acquisition of cues
- Screening of cues

ACQUISITION OF CUES

The Teplin and Lutz study and the Compton study cited earlier provided an initial list of observable cues with at least some demonstrated validity in the assessment of BAC levels. The first step in developing a procedure of BAC estimation that improved upon those of the earlier investigators was to compile a comprehensive list of cues having at least potential value in identifying levels of alcohol impairment. The following sources of information assisted in this effort:

- Scientific and technical literature
- Observations in bars and restaurants
- Focus group discussions

Review of the Literature

Prior to initiation of the project, the project staff completed a study of server intervention (McKnight, 1988) which led to identification of 220 cues of alcohol impairment. While some of these came from the scientific literature, the majority were the product of lore rather than science and were found in educational materials and popular articles intended for servers of alcohol. The cues fell into four categories: physical, individual behavior, object-related behavior, and social behavior. Within each category, they were subdivided between *objective* cues, that is, cues that were directly observable, (e.g., staggering, giggling, etc.) and *subjective* cues, that is, cues that could only be experienced by the drinkers themselves (e.g., dizziness, anxiety, confidence), and which would have to be reported by the subjects. The availability of this initial list of cues allowed the literature survey to focus primarily upon scientific reports providing data that related cues to alcohol consumption and BAC.

To facilitate the storage and retrieval of cue-related information, the cues were categorized and assigned a numerical code. The complete list of coded cues appears as Appendix A to this report. The scientific literature came from three abstracts provided by three major abstracting services: The Transportation Research Information System (TRIS), The National Institute of Alcohol Abuse and Alcoholism (NIAAA), and the

National Library of Medicine (MEDLARS). The number of abstracts from each source was as follows: TRIS N=162, NIAAA N=18, MEDLARS II N=114.

As might be expected, there was a great deal of overlap among the sources. And, as is typically the case, only a minority of the abstracts were truly relevant to the identification of cues. Of the references identified in the abstract, 32 appeared sufficiently relevant to warrant recourse to the original document. A total of 12 references provided usable information.

To be considered "usable", the reference needed to provide information that could be considered "authoritative," in that there was a sound basis for considering the information to be correct. In some cases, the basis lay in empirical research relating behavior to measured BAC. In other cases, it could be more aptly characterized as "enlightened opinion," that is, opinions about impairment signs and associated levels of impairment from police officers and others who have been afforded an opportunity for relatively controlled observation of alcohol impaired people. Information was not taken from secondary sources such as information and education materials that failed to cite an authoritative source or opinions having a demonstrated basis in experience.

Observations of Drinkers in Bars and Restaurants

At the time this project was being initiated, observers were being sent into bars and restaurants in six different cities as part of a Server Intervention Project (McKnight, 1988). One of their tasks was to note whether they observed an impaired patron on the premises and, if so, to describe the server's response, if any. Recognizing that this activity provided a valuable opportunity to observe cues, observers were also asked to record the cues by which they judged patrons to be intoxicated.

Intoxicated patrons were observed in 334 of 1,580 visits to bars and restaurants. The cues identified by the observers were coded and their frequency of occurrence analyzed. The frequencies appear in the listing of cues in Appendix A, column 3 (observed frequency). The numbers represent the percent of times the cue was observed in the 334 trips to establishments where one or more impaired patrons was observed. For example, in over half of the trips to establishments in which an intoxicated patron was observed, at least one of the cues of behavior involved loud and boisterous behavior.

One caveat: the numbers represent the frequencies of the types of cues that are detectable by an observer at some distance from the patron. This is evident in the fact that the most commonly observed cues were being loud and being obnoxious. Many of the low-frequency and no-frequency cues would doubtless rank much higher if observers had been close enough to detect them. However, the information obtained from the

observers was valuable both in expanding the list of cues and providing frequency data on those cues that are detectable at distances.

Focus Group Discussions

A focus group session was conducted to determine if this route of access to impairment cues would be a productive one. To give the approach every possible chance, the group was made about as large and heterogeneous as possible. It included seven males and three females with ages ranging from 20-67 years. Three had an opportunity to deal with alcohol in their work -- a cocktail waitress, a bartender, and a retired police chief. The remainder were employed in a variety of unrelated occupations. As far as personal drinking was concerned, two abstained, most were light drinkers, two were heavy drinkers, and one was a recovering alcoholic.

The meeting took place over a three hour period. During the first hour, participants offered their own intoxication cues based upon their particular experiences. During the second two hours, they reviewed a preliminary version of the cue list in this report, both commenting upon their own experiences with the cue and using it as a prompt to stimulate recall of related cues. All participants remained the full three hours.

While the focus group members participated conscientiously, they added very little to what was already known. Their comments on and additions to the cue list appear in Appendix A, columns 4 and 5 (focus group). Based upon experience with the first focus group, the approach was not deemed a worthwhile expenditure of project time and funds and no further focus groups were conducted.

SCREENING OF CUES

The result of the processes just described is the list of cues appearing in Appendix A. This list was not only too long to serve as the basis of a practical impairment estimation but too long even to be subjected to the cue assessment procedures making up the second phase of the project. To help whittle down the number of cues, a group of professionals having experience in relating behavior to known BAC levels reviewed the list of cues and rated them.

Panel Rating

The entire list of cues was submitted independently to four behavioral scientists with extensive experience observing the behavior of persons known to be intoxicated. Three of the raters were psychologists whose observations were largely confined to laboratory settings in which dosed subjects performed a prescribed series of tasks.

Laboratory sessions also permitted the researchers an opportunity to observe other forms of behavior, particularly those involving interactions among subjects. The fourth panelist was a cultural anthropologist whose extensive field research involved observations of drinkers in bars, restaurants, and other settings in which intoxication often occurs.

The raters were provided a complete list of cues and asked to rate each cue with respect to the three factors that would most influence its utility in the estimation of impairment levels. These are:

Frequency -- The more frequently a cue occurs, the more useful it is. A cue that rarely occurs would not have much utility no matter how indicative it might be of intoxication.

Reliability -- This refers to the extent to which people can accurately observe the occurrence of the cue, a characteristic typically measured by assessing the degree to which different people agree or disagree on the occurrence of a cue. It doesn't matter how strongly related a cue is to intoxication if it cannot be reliably observed.

Validity -- In this case, the term "validity" refers to the relationship between the occurrence of a cue and intoxication. A cue that occurs equally often at levels of impairment well below intoxication and among the severely intoxicated does not have much validity.

The results of the rating process appear in the list of cues presented in Appendix A. The values provided represent the mean ratings across the four panelists for each cue and each of the psychometric characteristics.

A question may legitimately be raised as to the validity of the ratings themselves -- do they truly reflect the frequency, reliability, and validity of the cues? Since the true value of the characteristics being rated is not known (otherwise we wouldn't be using subjective ratings), an estimate of quality is typically obtained by examining the degree of agreement among the raters. While high agreement does not mean the ratings are accurate, a lack of agreement certainly undermines confidence in the combined results.

Agreement was assessed by correlating the results across the four raters. The average intercorrelation across the four judges fell in the .3 range for each of the three characteristics being measured. This means that only about $.3^2$ or 10% of the variability in ratings represent a common consensus. The ratings furnished by the cultural anthropologist, based upon field observations were quite noticeably different from those of the three psychologists whose observations occurred primarily under a controlled

setting. Among the latter group, correlations fell in the .4 range, indicating about 20% consensus, still rather low.

Another discouraging result was the high intercorrelations across the three characteristics being rated. The intercorrelations of rated frequency, reliability, and validity all fell in the .8 range, indicating that the raters were not making distinction among the characteristics they were rating. It is possible that the cues that occur most frequently are those that can be most reliably judged and are the most valid indicators of intoxication. Certainly blatant cues such as staggering, bloodshot eyes, and extreme boisterousness would seem to be examples of cues that rate high on all three characteristics in that they are frequently observed, are very easy to spot, and are clear indicators of intoxication. However, high intercorrelations among all cues suggests that the raters might have been judging one basic attribute of each cue rather than the three that were called for.

As one more check on the quality of the rating process, the frequency with which various cues had been observed in bars and restaurants during a server intervention project, shown in Appendix A, were compared with the ratings of frequency given to the same cues by the judges. Correlation between the observed frequency and mean rated frequency was statistically significant but not very high ($r=.42$).

Because of the high correlation among the three characteristics used by the raters, it was only necessary to use one of them as a selection criterion. Since *validity* is the most important of the three characteristics, it served as a selection criterion. The cues selected were those having the highest validity ratings and the lowest variance among raters (i.e., highest agreement). The specific criteria were a mean validity of .3 or greater and a standard deviation of 1.2 or less. The criteria chosen were fairly conservative, eliminating only those cues having a very low validity rating and high inter-rater variance. Of the 220 cues in the original list, 166 met the criteria. Given the questionable reliability of the ratings themselves, a conservative criterion was in order.

ASSESSMENT OF CUES

Each of the cues identified through the process just described was assessed for its relationship to level of impairment. This was done by observing drinkers for the appearance of various cues and then measuring their blood alcohol level. This section will describe the general approach to assessment of cues, the specific procedures through which the approach was implemented and the results.

APPROACH TO ASSESSMENT OF CUES

A number of considerations entered into the development of a procedure for assessing the relationship between various cues and levels of impairment. These considerations include:

- Observational procedure
- Drinking environment
- Impairment criterion

Observational Procedure

Three features of the procedure used to observe cues strongly affect the validity of the system by which impairment is estimated:

(1) The length of time over which observations of cues are made.

(2) The distance of the observer from the subject.

(3) The extent to which an observer and a subject directly interact.

Length of Time

Most of the behavioral and physical cues of impairment are capable of being observed at a particular moment in time. Slurred speech, boisterous behavior, ordering one drink before another is gone, and so on can be observed in a relatively short period of time. Of course, being able to observe a drinker for 10 to 20 minutes can lead to observations of many cues and may help improve the estimation of BAC level. However, as long as the drinker keeps imbibing, there's a limit to how long the observations may continue before the additional alcohol consumption leads to a higher BAC and a different set of cues.

Another class of cues such as counting drinks, counting changes in the number of cigarettes smoked, or observing personality changes not only permit observations over longer periods of time but actually require them.

There is a need for both types of cues. Sometimes drinkers will arrive upon the scene with a BAC level that is close to intoxication already. Observers (bartenders, hosts, friends) might only have a short time in which to estimate BAC and take action before the drinker becomes intoxicated. In other situations, people will have an opportunity to observe drinkers over a long period of time and can take advantage of these longitudinal observations in order to arrive at more accurate estimates of BAC. Friends, in a position to intervene and likely to do so, will normally have longer periods to make observations. Hospitality personnel -- waiters, bartenders -- may have to make more rapid judgments. The final observational method had to allow observations to occur over time so that cues would be scaled for their apparent utility in the short and long term observation settings.

Distance

Another factor in the validity of the test is the physical distance between observer and subject. Some cues are only evident at close range. For example, police officers routinely use the smell of alcohol to determine whether a person has been drinking. Other potential signs, such as bloodshot eyes, enlarged pupils and trembling of the hands may be difficult to observe from a distance. Use of these cues is limited to those cases where the individual can be observed closely. Other cues are capable of being observed over much greater distances. These would include chain smoking, spilling drinks, shouting insults, etc. Obviously, these cues have much wider application. The method had to allow observers to detect cues over a range of distances.

Interaction

The procedures used to estimate impairment could not be dependent upon voluntary cooperation of the individuals being observed. However, many situations in which cues will be used will permit raters and drinkers to interact with each other. Conversation for example is a useful elicitor of cues.

In the assessment of cues, it seemed appropriate for an observer to carry on a conversation with the drinker to make it possible for the observer to stimulate behavioral responses which were then useful in judging intoxication, without overtly putting the drinker through a test. While an individual sitting alone at the bar may not engage in any conversation, a server can stimulate a discussion which provides behavioral data such as slurred speech. Consequently, behavior which was stimulated through a "natural" interaction process was not prohibited from inclusion in the observer's tasks just because it required a form of cooperation on the part of subjects.

What it was necessary to avoid was conscious awareness on the part of subjects that they were performing tests designed to determine whether they were impaired by alcohol (other than during the BAC measurement procedures).

Drinking Environment

The conditions under which cues were tested needed to involve highly naturalistic settings. Any artificiality in the drinking situations or any restraint on the naturalness of behavior through knowledge that the drinker was being observed could have changed the character of the cues and the frequency with which they were emitted. Thus, it was necessary to develop the test for cues of drinking in as natural a setting as possible, such as parties thrown in private homes or in public drinking establishments.

Experience in conducting the observations under a NHTSA server education program, however, has indicated that the frequency of overtly drunken behavior in public drinking establishments is relatively low -- about one instance per hour of observation. It would, therefore, have been fairly expensive to try to observe only naturalistic situations in which the number of appropriate cases might be relatively small in relationship to the time spent in observations.

On the other hand, it was necessary to avoid bringing drinkers into a laboratory or other very formal setting to dose them with alcohol. Researchers using dosed subjects for performance tests have generally attempted to have the drinking occur in an informal situation outside the laboratory. In the development of a test which is dependent upon the subject freely emitting characteristic behaviors, the drinking environment and the "set" of the drinker have a significant effect. Any situation in which drinkers are being fed alcohol rather than controlling their own consumption has been shown to result in unnatural, uncharacteristic behavior.

Just as limiting might be the subjects' knowledge that they were being observed. It is not realistic to expect people to behave normally under circumstances in which they know they are being observed. This was, of course, the condition under which the study by Langenbucher and Nathan was conducted. The drinkers were clearly aware that they were under observation. In fact, in one condition, the subjects faced a jury of judges. It is unlikely in these experiments that the behavior exhibited was "normal". This may have had some effect on the validity of the judgments of the observers. It appeared desirable, therefore, that the procedures be developed under conditions in which drinkers were not aware that they were under observation.

The need to provide a setting in which subjects are free to interact in a natural way, one in which they are not cognizant of the fact that their behavior and physical appearance are being observed, may seem difficult to reconcile with the need to collect accurate blood alcohol data. The approach used here is one in which subjects knew

fully well that their BAC was being monitored (how could they help but know if a breath test was periodically administered?), but, with rare exceptions, they were unaware that their physical appearance and behavior were being observed and scored. This was done by informing subjects that they would be participating in a study in which they are evaluating breath testing devices.

Impairment Criterion

Blood alcohol concentration (BAC) was used as the primary criterion in validating behavioral and physical cues. Data collected on the number of drinks consumed were intended to serve as a secondary criterion.

Limitations of BAC

It is important to recognize that BAC, while a useful measure known to be highly correlated with impairment, is nevertheless not perfectly related to the level of crash risk. It is the lowering of the risk of motor vehicle and other accidents for which the study of intoxication cues is primarily intended.

It is well known that light drinkers (once a month or less) are at significantly greater risk of crash involvement at any specified BAC when compared to heavy drinkers (daily). This was demonstrated by Hurst's reanalysis of the Grand Rapids data as well as the study by Farris et al. of injury accidents. In addition, it is known that at a given BAC, teenage drivers are at higher risk of a crash than are older drivers. There is also some evidence that women are at a greater risk at any given BAC level than are males. Thus, using only BAC as a criterion, one could underestimate the crash risk level for inexperienced drinkers, youthful and female drivers, among others. Nevertheless, BAC is such an objective, quantifiable measure, that it is a far more effective criterion for test development than other measures such as gaze nystagmus or a performance test.

Drinker Characteristics

Individual variations in the relationship between the BAC and driving risk lead to the conclusion that it might be useful to add to the basic BAC criterion other factors, so long as *they can be easily observed by members of the public.* If a given BAC produces a greater behavioral impact upon a teenage drinker than upon an older person, then the signs or symptoms used in the "test" will predict a higher BAC than the teenager actually demonstrates. Conversely, for the older person, it will predict a lower BAC. Such age differences would add to the error variance if no differentiation is made by age of drinker. If, on the other hand, the research demonstrates that the symptoms of the young and old drinker are correlated with age, then it should be possible to make a correction on the item weights or simply have separate tests for

teenagers and older drivers. Similarly, separate tests could be constructed for males and females.

The critical feature for use of different scales was that the drinker characteristic must be easily observable by the person using the test. Only very obvious factors, such as age and sex are potentially useful. This information needed to be collected and given an identifying code for all drinkers so that later correlation with drinking and cues may be discovered.

Alcohol Tolerance

The relation of BAC to driving impairment and crash risk is confounded also by differential tolerance for alcohol. It is well known that different drug effects show different rates of tolerance. For example, with heroin, the subjective high shows rapid tolerance relative to the respiratory depression effects. As a consequence, overdose deaths are common among older users trying to recapture their previous experiences.

Similarly, alcohol shows differential tolerance. The use of the nystagmus test by a trained police officer provides a rough measure of the tolerance to alcohol of more experienced drinkers. Based on that test, one could determine the validity of the cues for predicting alcohol as a function of the tolerance to alcohol of each individual.

The ideal test of tolerance should meet two conditions:

1. It should be usable without extensive training.

2. It should not cause subjects to think they are being tested.

Moreover, it would ideally be used in situations where observers had a way of knowing how much alcohol had been consumed. It is the knowledge of performance on a measure, *coupled* with knowledge of alcohol consumption (or BAC), that provides insight into tolerance. While gaze nystagmus doesn't meet the two conditions listed above, other possible measures were considered. During the assessment process, subjects were given a reaction time, memory span, and time estimation task. None of these required training to administer and while they definitely would appear as "tests", each seemed more like a game than a gaze nystagmus test.

ASSESSMENT METHODS

Observation of behavior and the measurement of BAC took place through seven social events in which 20-25 individuals consumed alcohol over a period of several hours and were administered breath tests after every two drinks.

Social Setting

It was imperative that the social setting be one that would lead to the type of social interaction that typically occurs at occasions where alcohol is consumed. Most of the cues involved social behavior that would not occur unless the conditions were such as to encourage it. The way this situation was created was by inducing seven different organizations to hold parties for friends or members of their organization with the understanding that they would agree to have measures of their blood alcohol taken at periodic intervals. Having a mutual affiliation was intended to assure that participants either knew one another or at least had enough in common to lead to the desired social interaction. In exchange for hosting the party, the organization received a contribution to help further its efforts. The groups included two yacht clubs, an amateur theater group, a graduate school department, a business organization, a professional group, and a purely social group.

All events were held in private homes. Breath tests were administered in a separate room, away from the party itself, so as not to intrude upon the party atmosphere.

Solicitation of Subjects

Each host was responsible for soliciting 20-25 participants. The subjects were informed ahead of time that they were taking part in an experiment in which they were expected to drink as much as they could and be given breath tests periodically. They were informed that the purpose of the experiment was to assess a new type of passive breath testing device. There was indeed truth to the stated purpose in that breath tests were administered both through evidentiary devices and passive sensors, the former being used only as a criterion to validate the latter. They were also told that they would be observed, the purpose of the observations being stated as protection of the drinkers and to keep the event under control; that data would be collected anonymously; and that no record would be kept of their names.

In order to participate, subjects had to agree to be transported to and from the event by a member of the project staff or by someone of their own choosing (wife, date) who was not allowed to reach a BAC greater than .04.

Administrative Procedures

Arriving at the drinking event, subjects were asked to fill out a short questionnaire providing personal history information and describing their general level of consumption for various types of alcoholic beverage. Printed on each questionnaire was a code number which appeared on a name tag (with no name) that subjects were

asked to wear. The code number was used for identification purposes by observers and the staff administering breath tests.

Upon completing the questionnaire, subjects were referred to the breath testing station where they were given the breath tests and tolerance measures. These will be described in further detail momentarily. After completing the tests, subjects were given two drink coupons. They were advised that after consuming the second drink, they could return for testing and receive two additional coupons, and so on through the evening.

The coupons were redeemed at a bar tended by a member of the project staff. While a full range of beverages was available, the bartender poured each drink in such a way as to assure that it contained .6 ounces of alcohol, that is, 1-1/2 ounce shot of liquor, 5 ounce glass of wine, or a 12 ounce can of beer (16 ounce in the case of light beer). The bartender wrote down the code number and the time at which the drink was served.

As an inducement to consume enough alcohol to reach higher impairment levels, subjects were promised a "I Sipped for Science" button if they reached a BAC of .05%, and an attractive certificate of their participation in the study if they reached a BAC of .08%.

Test Administration Procedures

As noted, tests were administered at the beginning of the evening and after each two drinks. The use of the coupons provided an easy way of keeping track of the drinking.

Upon reporting for testing, subjects were given a glass of water and asked to rinse their mouths. The elicited cue tests devised to estimate tolerance were then administered, serving both to collect data and to allow time for mouth alcohol to dissipate before the breath tests were administered. The three tests were as follows:

Reaction time -- An easy measure of reaction time was to position the lower end of a ruler between a subject's thumb and forefinger and then drop it unexpectedly. The reaction time was measured by the extent to which the ruler dropped, measured in inches, before it was caught.

Memory span -- Subjects heard a set of digits and were asked to repeat them backward.

Time estimation -- Subjects were asked to judge a ten second span.

Following completion of the elicited performance tests, subjects were administered a breath test. The three devices used were the CMI Intoxylizer, the Alcosenser Intoximeter, and the Lion Alcolmeter SD-2. It was necessary to have several pieces of equipment available in order to allow prescribed equipment recovery times without creating a bottleneck in the testing process. An average of twenty evidentiary tests were administered per hour.

Subjects were also administered breath tests with a number of different experimental passive sensors immediately before or immediately after the evidentiary test. In addition to being a part of the explanation given for the measurement process, these measures were used to assess the accuracy of the passive sensors.

The results of both the tolerance measures and the breath tests were recorded by subject code number. No record was kept of subject names. Those who qualified for the certificate (BAC >.08%), were invited to enter their name in a book so that their certificates could be properly inscribed.

Subjects reaching a BAC of .12% were issued no more coupons and asked not to consume any additional drinks unless or until their BAC fell below .10%. Termination of service at this point was intended to keep participants from reaching a level of intoxication at which they might injure themselves or renege on those precautions intended to prevent injury (there was no way to force participants to comply with procedures). Further, there was no advantage in allowing participants to reach BAC levels beyond .12% since the cues of impairment appearing at such levels are rather obvious; the purpose of the study was to identify cues appearing at the threshold of illegal intoxication (i.e., .08-.10%).

Observation Procedure

Five observers participated in each event. Four observers were given specific assignments to observe five designated people. The first digit of the code number (1-4) was the group designation. The fifth observer observed and reported upon all subjects. This practice was employed to provide some measure of inter-judge agreement without calling for complete duplication of observations.

The observers were all behavioral scientists. Two were members of the project staff while the other three were senior graduate students in psychology. The task of observers was to note the appearance of any one of the cues on the list of cues. When they observed such an occurrence, they were to make note of the subject code number, the cue, and the time at which the observation was made.

To help the observers learn the cues, the 166 cues surviving the screening process were grouped into 60 cluster categories. These categories in turn were grouped

into six types: appearance, perceptual, cognitive, emotional, motor, and drinking behavior. The first five categories were more functional for a group of behavioral scientists than the highly phenotypic types making up the original list. The sixth category, "drinking," represents behaviors that do not fit into the five functional categories because they deal entirely with the highly specific process of drinking. The revised cues appear as Appendix B.

During preliminary trials, observers were "wired" with tape recorders and lapel microphones in order to be able to record their observations without attracting attention. However, it became evident that cues did not occur so frequently as to make such a procedure necessary. At the same time, the use of recording devices carried with it the danger of detection and the arousal of suspicions that might bring the event to an end. Given the imbalance of benefits and risks, the procedure was abandoned in favor of calling upon observers to simply make note of their observations, retiring periodically to some area in which they could not be observed (bathroom, guest room, back yard) to audio record their observations from the notes they had made.

Nothing occurred during the seven events to indicate that any of the subjects was aware that their behavior was being recorded. Nor is it likely that such knowledge would have affected their behavior. The overwhelming majority of subjects became quite taken with the breath testing process and results and were quite willing to "play the game," no matter what it might have been. While it was apparent that they were aware they were being observed, it was also apparent that they didn't think it was out of the ordinary to be watched under such circumstances.

Protection of Subjects

The procedures that were taken to protect participants in the experiments from the risk of injury or prejudice included the following:

- Not requesting subjects to do anything that they didn't feel entirely comfortable in doing and terminating service of alcohol once subjects exceeded clear illegal intoxication (>.12% BAC).

- Collecting all information anonymously through the use of code numbers that could not in any way be connected with the identities of the subjects.

- Having a registered nurse or certified emergency medical technician on hand from the beginning to the end of the event.

- Making sure that each drinker was provided transportation to the event by the staff or a designated driver in order to make it virtually impossible for them to attempt to drive themselves home.

RESULTS

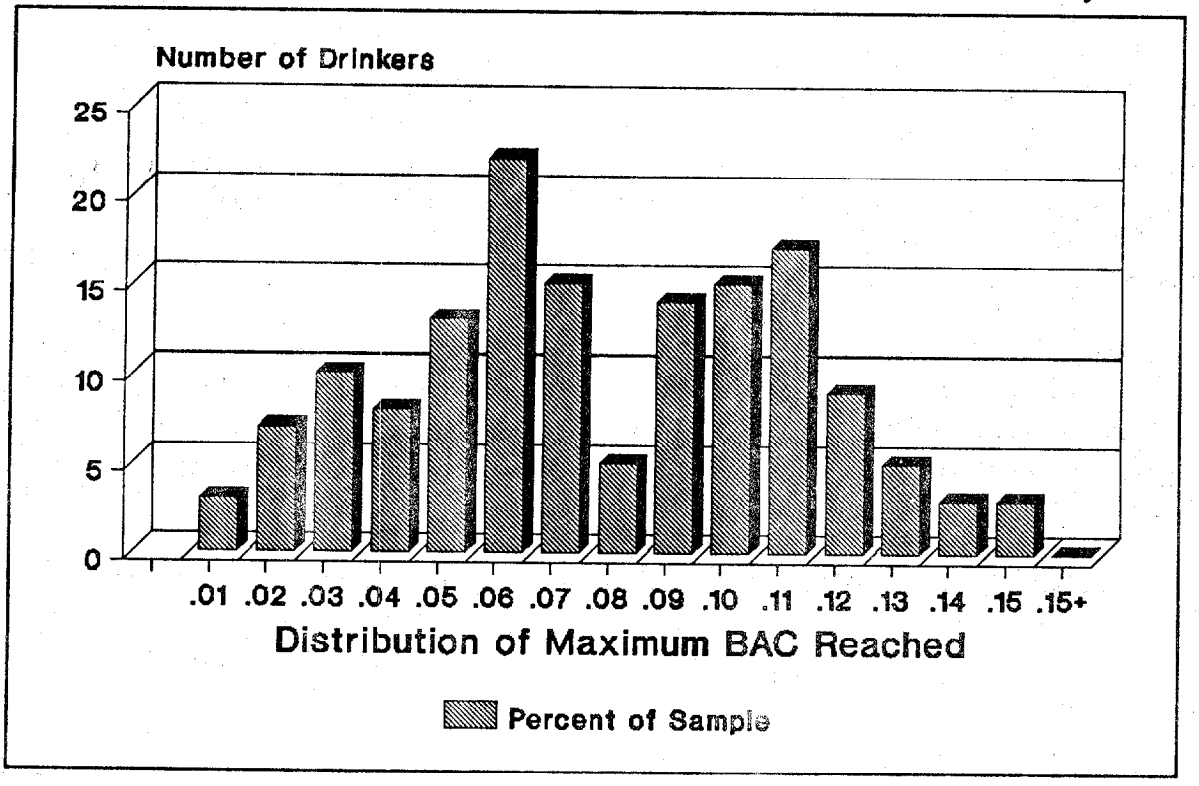
This section will describe the results obtained through application of the procedures that have just been described. The presentation of results will be divided among the following sections:

- Derivation of BAC
- Selection of cues
- Preliminary impairment estimation procedure

Derivation of BAC

BACs were recorded for 149 subjects over the seven drinking events. Figure 1 shows the distribution of maximum BACs achieved by the subjects. All but 10 of the subjects exhibited one or more cues. This section will describe the manner in which BAC values were associated with cues, as well as providing some data bearing upon the reliability of the BAC measures.

Figure 1
Distribution of Maximum BAC for Subjects of Cue Assessment Study



Assigning BAC Values to Observations

The first step in analyzing the data was to assign a BAC value to each observed cue. The time at which a cue was observed rarely corresponded to the time at which BAC measures were taken. The only way to assign a BAC value to a particular cue was to interpolate between the BAC measures taken prior to and following observation of the cue.

The analysis of data involved primarily plotting the relationship between the appearance of cues and the mean BAC at the time each first occurred. Because breath tests were not given at the moment cues were observed, some interpolation was required. Since BAC cannot be assumed to rise in linear fashion, a straight line of best fit between the BAC points measured during the evening would not provide a completely accurate estimate of BAC at any one point of time. The alternative was curve fitting for each drinker and interpolating between BAC values on an individual case basis.

Despite the small degree of error introduced, interpolation was carried out on a linear basis. The time at which a cue was noted was expressed as a fraction of the time between the preceding and subsequent BAC measurement. This fraction was then applied to the difference between the BACs. For example, if a cue was observed thirty minutes following a BAC measure of .02% and thirty minutes prior to a BAC measure of .04%, the interpolated BAC value equalled .03%.

BAC Measures and Number of Drinks

It is worth noting that the BAC measuring devices were very good at predicting the number of drinks. From a linear regression analysis of the BAC data and number of drinks, both devices show that each drink raises BAC by .016% for the average drinker. Depending on the service, the coefficient of determination shows that between 85% and 88% of the variance in BAC (R=.92, .95) is predicted by number of drinks. This is noteworthy because it reflects the precision of the procedures embodied in the experimental design.

One might expect that a substantial portion of the error in predicting BAC from number of drinks arises from differences in the body weight of the drinkers. To determine the extent to which this was true, subject body weight was correlated with the residual error (with regard to sign). The result was a correlation of -.45, indicating that as weight increases, the same number of drinks tends to produce a lower BAC. The correlation indicates that approximately 20% of the residual error is accounted for by differences in weight.

Consistency of Measuring Devices

While the measurement procedure only called for use of one evidentiary device, there were occasions during which the availability of time and equipment allowed both the Intoxylizer, an evidentiary standard which uses the infrared method of detection, and the Alcolmeter (SD2), an electrochemical fuel-cell device for BAC measurement, to be used on the same subject. There were 32 such occurrences of joint measurement. While the two devices were generally in agreement (R=.92), a constant difference appeared between the two devices. The Alcolmeter gave consistently higher readings than the Intoxylizer, the difference being highly significant (T=3.9, p=<.01). The differences for each of five BAC levels are summarized below.

BAC Interval	Mean Diff. (±SD)	Cases
.02-.04%	.012 (.006)	6
.04-.06%	.012 (.008)	8
.06-.08%	.008 (.003)	5
.08-.10%	.010 (.027)	8
.10% +	.014 (.021)	5
Mean	.011 (.016)	32 (tot)

It was learned that the Alcolmeter devices were set on the European standard (2300:1) for equilibration between breath and blood alcohol concentration. The European standard routinely measures BAC at .01% higher than the American standard (2100:1). at which the Intoxilyzer was set. It was decided to adjust downward by the overall mean difference (.011) all Alcolmeter measurements in order to bring them into accord with the Intoxylizer.

Rinse Time Interval

Because of the importance of the mouth rinse time interval before taking a BAC measure, rinse time was noted prior to all BACs. The stipulated rinse time interval of four minutes between mouth wash and BAC was not observed in four cases. In those cases, each BAC measure was unreasonably high. In order to correct for this, the data were adjusted downward by applying each drinker's BAC function (derived from the other BAC measures, and timing, rate and number of drinks associated with all other measures). The resulting adjustment caused the data from the short rinse instances to fall on the BAC line with the other measures.

Selection of Cues

This section describes the analyses that were conducted with the 60 interim cues and the selection of cues on the basis of those analyses. Many of the cues were only observed on a few occasions. To assure a reliable estimate of BAC, only those cues occurring four or more times with standard deviations of .045 or less were subject to analysis. Imposition of this criterion reduced the number of cues to 31 cues out of a total of 678 observations. It should be noted that, given their rarity, the 26 deleted cues would not have been of much practical benefit in estimating impairment levels unless they were much more accurate in predicting BAC than the remaining 31 cues. Such was not the case.

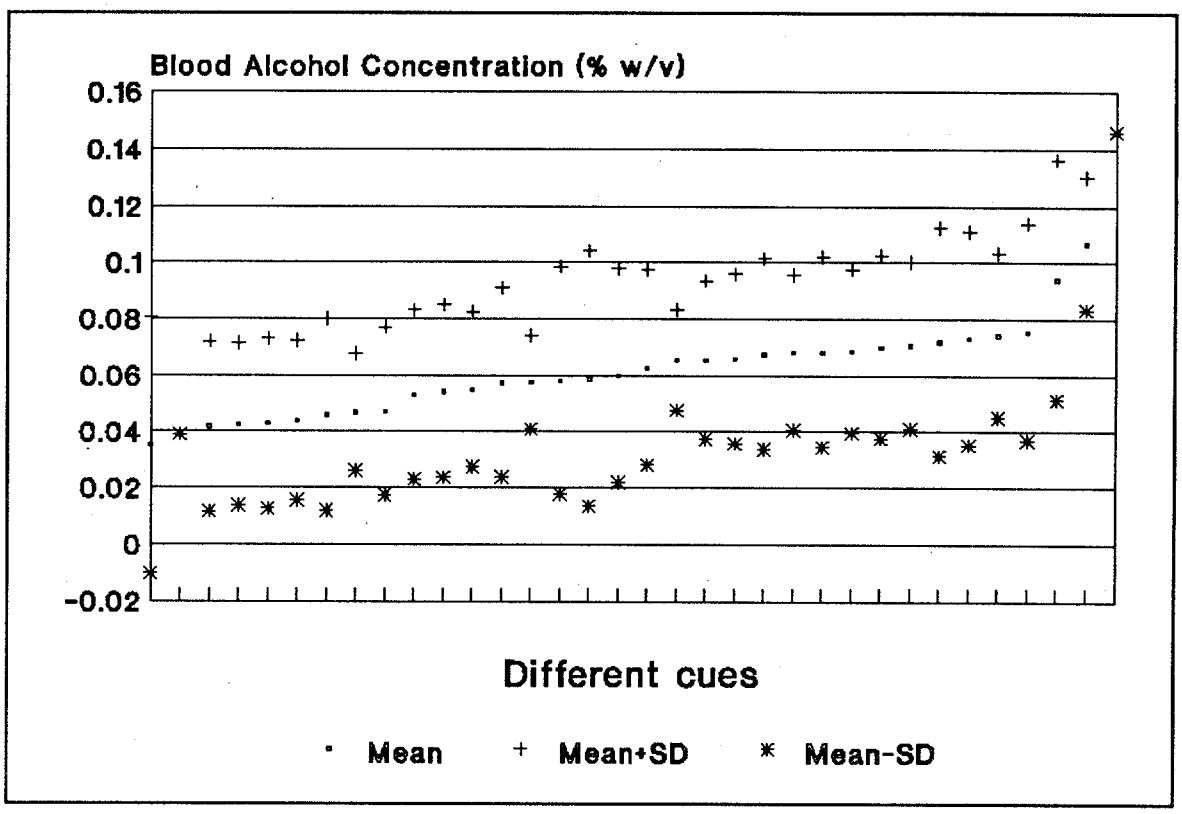
Cue-BAC Relationships

Cues were logged into the dataset only on the first occurrence of each cue for each drinker. This was necessary because of the continuous nature of many cues. Time of first occurrence presumes that some threshold level of BAC has been reached. Therefore, a cue, once noted, had no further entries for that drinker. The relationship between BAC and cues is shown in Figure 2, which displays means and dispersion (±1 SD) for each of the 31 cues that remained after the redefinition process. Since the cues have no inherent sequence to them, they were arrayed along the abscissa in terms of increasing BAC, hence the monotonic relationship appearing in the figure.

Table 1 lists the cues themselves from all seven events after redefinition along with their associated frequencies, means, and standard deviations. It is the latter characteristic, dispersion around the mean, that provides the best measure of a cue's accuracy. It is evident that several of the cues in the "Severe Impairment" category have mean BACs below .08% and two cues (10,21) averaged slightly lower mean BACs than one cue of "Moderate Impairment" (19). There is obviously no clear demarcation between the two impairment levels. Borderline cases were not decided on the basis of mean BAC alone, some deference being given to the literature that has served as a source of the cues. For example, casual physical contact among drinkers is not generally considered a sign of intoxication whereas weaving and having one's clothing askew are frequently treated as signs of intoxication. The IEP called for treating the borderline cues as just that and taking into consideration how many were being observed before assigning the drinker to one of the two categories.

Figure 2

Distribution of Means and Standard Deviations of
Frequently Observed Cues



Validity of Cues

Before proceeding with the selection of individual cues, it was necessary to determine whether the differences among the mean BACs represented true differences among the various cues or whether they could be as easily a function of chance. An analysis of variance was carried out to ascertain whether the variance among the means was significantly greater than that which might be expected from the relatively high BAC variance within each cue. The resulting F was 3.21 with an associated probability of $p<.001$. Differences among the cues accounted for 14.3% of the total BAC variance.

TABLE 1
Means and Standard Deviation of Cues Observed
In Assessment Study

Cue	Description	Mean	Std	N
1.	Elation	0.058	0.017	6
2.	Completely laying down (floor, couch, etc.)	0.065	0.018	8
3.	Manual dexterity - fumbling, imprecise	0.077	0.021	16
4.	Movement/balance disruption - extreme, falls down	0.017	0.023	4
5.	Directs insults toward others, thoughtless, hostile	0.081	0.045	5
6.	Red, bloodshot eyes	0.055	0.028	22
7.	Very loud, extreme attention seeking	0.065	0.028	34
8.	Bleary, blank, unfocused, glazed eyes	0.044	0.028	13
9.	Louder than normally appropriate	0.043	0.029	40
10.	Clothing askew, hair mussed	0.069	0.029	4
11.	Declining sociability, withdrawal from group	0.074	0.029	9
12.	Major loss of social boundaries (e.g, public urination)	0.071	0.030	14
13.	Generally more convivial (alcohol-assisted)	0.047	0.030	37
14.	Slow speech, lisps, some difficulty enunciating	0.066	0.030	19
15.	Disinhibition, "hyper,", slight profanity	0.053	0.030	27
16.	Expanded gestures, feeling rhythm	0.043	0.030	64
17.	Removes shoes clothes loosened, feeling casual	0.043	0.030	10
18.	Leans on walls/objects for minor support	0.054	0.031	36
19.	Physical contact, sexual overtures	0.070	0.032	24
20.	Silly, flirty, smug, cute	0.057	0.034	30
21.	Weaves while walking, stumbles, outrigger hands	0.068	0.034	31
22.	Rude, argumentative, pushy	0.068	0.034	12
23.	Red-faced, flushed	0.046	0.034	44
24.	Casual physical contact, touching, closeness	0.063	0.035	39
25.	Speech precision lost, slurring	0.073	0.038	16
26.	Heavy eyelids -- not just tired	0.060	0.038	29
27.	Poor perception - slow, cautious, shaky, drops things	0.076	0.039	14
28.	Self reported warmth, sweating, removes clothes	0.058	0.040	13
29.	Cognitive confusion, forgetful, mental errors	0.072	0.041	20
30.	Off-balance, swaying	0.094	0.043	13
31.	Stooped, limp, leaning	0.059	0.045	12
32.	Six or more of the above	0.085	0.030	

An additional measure of validity of the cues can be obtained by comparing results for the subjects exhibiting cues (N=139) with those who fail to exhibit any cues throughout the evening (N=10). The mean BAC for the group not evidencing cues was .045%, while the mean BAC of those exhibiting cues was .08%. The difference of .035% BAC was significant ($t=3.6$, $p<.004$).

The results indicate that, while the various cues exhibit considerable degree of overlap in associated impairment level, they do have some degree of statistical validity in leading to estimation of impairment level.

Tolerance and Drink Experience Factors

The relationship between BAC level and cues has long been believed to be mediated by age and experience with drinking, which are thought to effect one's tolerance for alcohol. Weight has also been suggested as a tolerance factor, although its primary effect is to mediate the relationship between number of drinks and BAC rather than between BAC and behavior.

If age, drinking experience, and/or weight affect tolerance, then differences in these variables could obscure the relationship between BAC and cues. In testing for these effects, the sample on each of these variables can be stratified and the BAC-cue relationship within each stratum can be examined. Because of the limited frequency of some cues, the analysis could address the effect of only one factor at a time; any attempt to stratify on the basis of cue, age, experience, and weight simultaneously would result in many zero-frequency cells.

Age

Age as a factor was highly significant in relation to BAC level ($F=62.5$; $p<.001$). Drinkers under age 40 averaged .024% higher BAC than those over that age across all observations of cues. This, in itself, is no measure of tolerance; younger drinkers simply consumed more. However, its effect upon the relationship between cues and BACs was relatively large; holding age constant raised the proportion of variance associated with cues from 14.6% to 22.2%.

Weight

The relationship between weight and BAC was also quite significant ($F=28.44$; $p<.001$). Subjects weighing under 140 pounds averaged .017% BAC higher than those over that weight. As in the case of age, this just indicates greater consumption.

With the sample stratified by weight, the variance associated with cues is raised from 14.6% to 18.2% of total variance. It doesn't appear that differences in weight had a large effect upon cue-BAC relationships.

Sex

Like age and weight, sex was significantly associated with BAC level ($F=6.64$; $p<.01$). Surprisingly, the females averaged higher BACs than the men. However the actual difference was negligible, the two groups averaging only .006 difference. The effect of holding sex constant was to raise the proportion of cue-associated variance from 14.6% to 15.4%.

Drink History

Subjects were asked four questions concerning their drink history. The relationship of these questions to BAC and the Cue-BAC relationship were analyzed.

1. "*How often do you drink alcohol*" -- Responses to this question were found to be unrelated to BAC level across cue observations. Those who drank more frequently than twice a week were not different than those who drank less frequently.

2. "*How much do you drink in one sitting, or session?*" -- Responses to this question were significantly related to BAC ($F=14.9$, $p<.001$). Those who consumed two or fewer drinks routinely had a mean BAC .009% less than those heavier drinkers. Still it was not much of a factor in cue-BAC relationships. Stratifying the sample by question two raised the variance associated with the cues from 14.6% to 16.6% percent.

3. "*How much do you drink when you drink more than your usual amount?*" Of the drink history questions, this showed the highest relationship to BAC ($F=31.6$, $p<.001$). Those who consumed less than the equivalent of a six pack, or six mixed drinks had, on average, a BAC of .014% less than those who were inclined toward higher situational consumption. Holding this constant increased the variance accounted for from 14.6% to 19.4%.

4. "*How often do you drink more than your usual amount?*" -- As with number 1, this question was without influence on the cue-BAC relationship.

Final Cues

As a group, the 31 behavioral cues showed a sufficiently significant relationship to BAC to warrant their continued refinement. The substantial variation among cues

with respect to standard deviation indicates that the individual cues differ in the accuracy with which they estimate BAC. However, the number of observations involving many of the cues was not sufficiently great to justify deleting individual cues on the basis of high standard deviations. All of the cues were capable of making some discrimination and therefore warranted inclusion in a BAC estimation procedure.

The behaviors reported by observers were not entirely compatible with the classification of behaviors represented by the cue list in Appendix B nor did they represent the most useful structure within themselves. The list of cues presented in Table 1 represents some restructuring of the original list. In some instances, this restructuring involved grouping into a single cue those cues that seemed to be functionally similar. This grouping not only simplified the use of cues, but increased the number of observations of that cue, thereby leading to more reliable BAC estimation. Conversely, some of the final cues represent subdivisions of an original cue into finer gradations. The cues described in Table 1 are the revised cues.

Elicited Cues

Several cues were elicited through tests created by the project staff. It was hoped that the differences in impairment indicated by BAC vs. elicited cues would provide a measure of tolerance. The ruler drop performance (the time lag between dropping a 12 inch ruler and the test subject grabbing it) was marginally poorer (not significantly) with increasing BAC. The apparent practice effect -- in which skill increased sharply with trials -- was stronger than any measurable performance loss that related directly to BAC. Even after discarding the first two trials at baseline, the alcohol-mediated degradation of performance -- if present--was too weak to measure.

The digit span backwards test, in which a subject was required to repeat back in reverse order four digits read in sequence, showed no relationship to increasing impairment at the BACs recorded in these preliminary studies. This was the case for both accuracy of recall and response latency. Both aspects of drinker performance improved with repetition.

Time estimation, in which the drinkers were required to indicate when ten seconds had elapsed, was similarly not impaired at the BAC levels under investigation in these cue assessment studies.

Consequently, these simple elicited cue procedures which met the procedural criteria specified earlier as ideal tolerance tests, failed to discriminate among BAC levels. For this reason, elicited cue procedures were dropped in the final phase of this project in favor of structured field sobriety measures of performance.

DEVELOPMENT OF IMPAIRMENT ESTIMATION PROCEDURE (IEP)

The validation of an Impairment Estimation Procedure (IEP) was actually the task of the next phase of this study. However, a preliminary procedure was developed and applied to the BAC data gathered in the cue assessment phase in order to see how well it estimated BAC. Certainly, an estimate of validity that was based upon the data from which the estimation procedure was gathered would be inflated since many of the relationships upon which it was based were chance covariations.

When applied to independent sets of observations we must expect the magnitude of relationships with BAC to shrink, just as multiple regression coefficients almost invariably decline when applied to samples other than the one from which they were generated. However, it provides a critical test of the cues in that if this coefficient were too small to be of practical value when applied to the source data, it would certainly prove worthless in later applications.

The general approach to BAC estimation suggested by the data is one in which cues are assembled into a scale based upon the mean BACs associated with each cue. Where one or more cues is presented at the same time, the best estimate of BAC would presumably be an average of the BACs associated with individual cues.

Test of Estimation Procedures

In actual practice, estimates of impairment level will be made by observers at the time a cue is observed (or not observed, where the subject is unimpaired). The data summarized here were collected on the form of cue observations, not as impairment level estimates. However, it was possible to assign cues to impairment levels after the fact since observers, had they made impairment estimates, would have made their assignments on the basis of the impairment category to which the cue was assigned. This process was easily set up, and the results of such a post-facto impairment estimation process are reported here.

Obviously a procedure that requires memorizing the specific BAC levels of 34 cues would be extremely difficult to apply and is therefore not likely to see much use. A more practical scale would simply group cues into broad intervals of BAC. All that users of the scale would have to do is simply associate cues with intervals. Two separate systems for estimation were derived: a three-category and four-category system:

Three Category		Four Category	
Category	BAC	Category	BAC
1	0-.04	1	00-.02
2	.04 -.08	2	.02-.05
3	over .08	3	.05 -.08
		4	over .08

An observed cue was assigned to the impairment category corresponding to the mean of the distribution of that cue. People were assumed to continue at the assigned impairment level until they manifested a cue that was indicative of the next higher BAC interval. Until the first cue was observed, people were considered to be in the first (BAC .00-.04%) category.

Contingency Tables

Table 2 displays contingency tables showing the real measured BAC interval and that estimated by observers, the latter being a derived number based upon the mean BAC of a cue's distribution after the first occurrence of that cue. Until the cue report was made for an individual, the estimated BAC was set equal to the mid point between .00 BAC and the bottom of the first impaired category, that is, .02% in the three category case and .01% in the four category case.

At the time any cue was observed, the "estimated" BAC was placed in the category corresponding to the mid point of the BAC distribution for that cue. If, for example, the mid point of the distribution for a particular cue were .06%, that observation would be assigned to the second category. The "actual" BAC was assigned to a category based upon the interpolated value described earlier. For example, if the BAC had been measured at .04% a half hour earlier, and at .08% a half hour later, the interpolated value would be .06%, which would fall in the second category. The numbers in parentheses are chance or expected numbers in each cell, given by the product of the marginal totals divided by sample size.

The correct estimates, or "hits", are those cells in which the estimated and actual intervals are the same, i.e., the diagonal. In these cells, the actual hits are greater than the expected hits in both the three- and four-category cases. This is evidence of success in estimation of BAC. In the four-interval case, observers "hit" 31% in the correct categories (along the diagonal) where chance performance would have been 23%. This represents 8% better than chance. In the three-interval case, observers "hit" 53%, which is 15% better than the chance performance of 38%.

Table 2

Estimated vs. Measured BAC for Three- and Four-Interval Impairment Classifications Schemes

Four Interval Scheme

	Measured BAC				
Count	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Row Total
Cat. 1	38 (24)	74 (59)	33 (39)	10 (33)	155
Cat. 2 Est.BAC	6 (9)	26 (21)	16 (13)	6 (11)	54
Cat. 3	16 (29)	43 (59)	44 (39)	53 (33)	156
Cat. 4	 (2)	2 (6)	2 (4)	11 (13)	15
Column	60	145	95	80	380

Three Interval Scheme

	Measured BAC			
Count	Cat. 1	Cat. 2	Cat. 3	Row Total
Cat. 1	97 (64)	48 (58)	10 (33)	155
Cat. 2 Est.BAC	59 87	92 (79)	59 (84)	210
Cat. 3	1 (6)	3 (6)	11 (3)	15
Column	157	143	80	380

Significance can be evaluated by Cohen's Kappa, a measure of the degree of agreement between the proportion observed and proportion expected.

Three Intervals (P_o =.53, P_e =.38)
Four Intervals (P_o =.31, P_e =.23)

$$\text{Cohen's Kappa is given by } K = \frac{P_o - P_e}{1 - P_e}$$

Where:

P_o= the proportion of the total number of observations on which the judged and actual (measured) levels agree.

P_e= the proportion of instances where, based on marginal totals (chance), judged and actual levels should agree.

The calculated Kappa value for the four-interval case is .1085. On the Z distribution, this corresponds to Z = 4.242 (P<.001). The three-interval case is even more significant, with Kappa = .2300, and Z = 6.180 (P<.001). Clearly, there is a strong association between cues and BAC.

Stepwise Multiple Regression

Analysis of Variance (ANOVA) techniques were used to estimate the proportion of BAC variance accounted for by the cues, with and without the inclusion of personal history variables. One might expect the proportion of variance associated with cues to increase with the deletion of cues having poor cue-BAC relationships. To see what effect a deletion of cues had, the cue-BAC relationships were reanalyzed using only the 31 selected cues. Since the purpose was solely to examine covariance, linear regression techniques were used instead of analysis of variance. The same caveats noted earlier with respect to the test of impairment estimation procedures also apply here; the relationships are bound to be inflated since the regression analysis was performed with the same data used to delete cues.

The correlation between measured BAC and estimated BAC is .4818 (P<.000). The proportion of variance in real BAC that can be accounted for by the cue-estimated BAC is R^2 = .23. The other drinker variables for which there are data are age, sex, weight, drinker history/preference questions (DH 1-4), and the number of cues previously recorded for each drinker at the time of each new cue. These have been added in a stepwise regression procedure to determine how much of the residual variance can be accounted for on the basis of known factors.

Table 3

Multiple Regression Statistics for Measured BAC and Estimates of BAC Based Upon Selected Cues and Personal History Variables

Variables Measured in the Equation

Variable	Correl	Part Cor	Partial	Mult R	Cum R^2	t	Sig.t
Est. BAC	.48	.20	.23	.48	.23	4.5	.0000
Drink Hist.3	.22	.17	.20	.53	.28	4.0	.0001
Age	-.24	-.15	-.17	.55	.30	-3.3	.0010
# of Cues	.44	.09	.11	.56	.31	2.1	.0330

Variables Not Included in the Equation

Variable	Partial	Min Toler	t	Sig t
Sex	.03	.33	.51	.6119
Weight	-.08	.34	-1.55	.1218
Drink Hist. 1	-.03	.34	-.58	.5622
Drink Hist. 2	-.05	.34	-1.01	.3140
Drink Hist. 4	.02	.33	.30	.7629

Table 3 shows the contribution of each variable in the final equation, including the correlation between the measured BAC and the variable noted, the part and partial correlations, the increasing multiple R at each step, cumulative R^2 -- the overall variance accounted for, and the t statistic. Values associated with the other variables that could not add significantly to the relationship follow.

Table 3 summarizes the results and includes the correlation between real BAC and significant variables as well as t- values. The addition of the second variable to the multiple regression, the responses to a drinker history/practices question (DH3), strongly improved the correlation ($R=.53$, $R^2=.28$). That question was, "how much do you drink when you drink more than your usual amount." The positive correlation means that those inclined toward higher situational consumption show higher measured BAC than would be indicated solely by the impairment cues. The magnitude of the partial correlation for DH3 is support for the idea that those given to excessive drinking can consume more alcohol "without showing it" than can more modest drinkers. Further it can be construed as a measure of the sensitivity of the experimental procedures.

The third variable added was the age of the drinker, which further improved the relationship (R=.55, R^2 =.30). From the direction of the correlation coefficient below, it is clear that younger drinkers show cues less readily at the same BAC than older drinkers. This jibes with information from the questionnaire showing that younger drinkers generally consume more alcohol than older drinkers in these drinking events. The additional variables had progressively less of an impact on lowering the residual variance. The final multiple correlation was R=.56, R^2 =.31. The stepwise procedure improved the amount of variance accountable from 23 to 31% of the total cue variance. Clearly, however, the cues themselves account for the majority of the variability that was found.

EVALUATION OF IMPAIRMENT ESTIMATION PROCEDURE

The assessment of cues, described in the previous section, was intended to determine the validity of selected cues for estimating the blood alcohol concentrations of drinkers in a social situation. It was established that the cues did significantly better than chance in estimating levels of impairment, whether impairment was divided into three or four levels. The greatest accuracy in estimating impairment level was attained when impairment was divided into three levels.

Bettering chance in the estimating of impairment level is not necessarily a noteworthy accomplishment. Most hosts and servers would surely exceed chance in estimating impairment levels simply from their own experience, without the aid of specified cues. What was at issue was whether hosts and servers using a procedure based upon the cues could do a better job of estimating impairment than could comparable hosts and servers without the procedure.

An assessment of the adequacy of an Impairment Estimation Procedure (IEP) based upon the selected cues was conducted using test methods similar to those employed in developing the procedure but modified to permit an evaluation of the procedure used. An estimate of whether the IEP improves the performance of observers within different observer categories was made by comparing the success of observers with and without the procedure. In addition to the procedure, the following factors were examined as study parameters to ascertain their possible interaction with the guidance effect:

- Gender
- Role (social host or professional server)
- Continuity of observation

The following sections describe the impairment estimation procedure, the evaluation methods, and results.

IMPAIRMENT ESTIMATION PROCEDURE

For the purposes of simplicity and ease of recall, the cues emerging from the previous study phase were rearranged and condensed into a 3x3 matrix. Three types of cue are crossed by three levels, or degrees, of impairment. The cues were clustered and segregated to form an impairment scale. This scale became the basis of the Impairment Estimation Procedure (IEP).

Types of Cues

The cue types are drawn from the most durable and reliable categories among those studied: behavior, appearance, and coordination. Appearance is a more static, or slowly changing, characteristic while coordination and behavior cues are usually dynamic and evanescent and therefore need to be more carefully observed.

Behavior

Social behavior is a cue to a drinker's emotional tone. It refers to the conviviality and smooth flow of conversation, to the social distances that one person maintains with respect to others. It refers to the occasional easy disregard for social convention. And it refers to the lapses from full engagement that a drinker may experience. These cues are dynamic, and may change rapidly. Conduct-change cues are more apt to come on after appearance-change cues have begun. Again, however, there are no guarantees as to sequence.

Appearance

Appearance refers to clothing, skin, and hair. Cues such as lying down and comfort-seeking generally have immediate consequences on the details of appearance, so these are included in this category. Its use as a cue is directed toward an assessment of the degree to which the drinker has become unconcerned with the details of his/her public image. This is not to suggest deviation from a proper standard, but rather a change from the drinker's own initial appearance. Appearance cues are often, but not always, the earliest to unfold.

Coordination

Motor control-related cues are key to the progressive muscular disability that comes with higher levels of alcohol intoxication. This can be manifest in obvious clumsiness, such as tripping or spilling drinks. Tongue control and speech clarity also reflect muscular precision. Motor control cues can also be subtly evident in the way a drinker begins leaning on things for support in order to bolster fading muscular rigidity. The most obvious of the motor impairment cues come in at the high end of the intoxication scale presented here, however, a few early indicators such as slouching and leaning are evident sooner.

Number of Cues

The list of 31 cues resulting from the earlier assessment process was compressed to a somewhat more manageable 22 by combining those cues that seemed to be fairly similar with respect to underlying mechanisms.

Levels of Impairment

The predictability of the three-category scale of BAC was found to be superior to a four-category scale and was, therefore, used in the IEP. The following terms will be used to refer to the various categories: *Slight Impairment* will correspond to a BAC between .00-.039%. *Moderate Impairment* will correspond to a BAC between .04-.08%. *Severe Impairment*, will cover all BAC values above .08%.

Slight Impairment

This level is basically distinguished by a lack of impairment cues. The cues that do exist are generally related to slight changes in appearance and behavior, suggesting that impairment has begun. However, since the degree of impairment cannot be considered dangerous, it is not a part of the Impairment Evaluation Procedure.

Moderate Impairment

Behavior

a. Physical -- Contact between drinker and others of either gender becomes more common
b. Loud -- Boisterous, noisy conversation
c. Uninhibited -- Some disregard for social conventions, mild use of profanity in story-telling
d. Close -- Reduced physical distance between drinker and others while in conversation, strangers talk more easily
e. Rude -- Pushy, thoughtless
f. Expansive -- Broad gesturing, suddenly elated
g. Convivial -- Very friendly, particularly with strangers

Appearance

a. Red-Eyed -- Red, bleary, droopy eyes
b. Warm -- Sweaty, claims to be warm, removes clothing
c. Silly -- May have self-satisfied glow, or a smug look
d. At ease -- Reclined position, often with feet up

Coordination

a. Slouching -- Stooped or limp, may lean on objects
b. Deliberate -- Speaks slowly, concentrates on speaking

Severe Impairment

Behavior

a. Uninhibited -- Social disregard, snooping, urinating outside
b. Hostile -- Extremely rude, insulting, pushing or cursing
c. Withdrawn -- Declining sociability, reclusiveness
d. Confused -- Loss of memory, indecisiveness

Appearance

a. Sloppy -- Slovenly, hair mussed, shirt out

Coordination

a. Stumbling -- Bumps into things, weaves, trips
b. Poor Perception -- Misjudging - distance, depth, sets drink down hard or on edge
c. Slurring -- Poor speech, may slur words
d. Fumbling -- Shaky, poor hand control, poor eye-hand coordination

Not all of the subjects manifesting cues in the "Severe Impairment" category during the cue assessment study had BACs in excess of .08 at the time. In fact, the mean BACs associated with these cues ranged between .070 and .081. They were, however, the only cues first appearing at BACs in excess of .08.

TEST METHODS

The fundamental question is whether or not knowledge of a procedure for judging impairment can improve the accuracy with which the average server or host can successfully anticipate the intoxication of guests. Implicit in the issue of measuring improved accuracy is knowledge of accuracy in estimating BAC without the procedure. Thus, one variable to be investigated was guidance, (i.e., guided versus unguided observation). Without knowledge of the performance of unguided observers there is no way to judge comparative success of those guided by the IEP.

It may be that certain classes of observers are more adept or more suited to the task than others. To approach this question, two observer variables -- gender and role (server versus host) -- were crossed with the guidance variable.

Guidance

Widespread use of the Impairment Estimation Procedure (IEP) requires that it be simple and easy to apply. Therefore, upon the study was imposed the restriction that guided observers not have to spend more than fifteen minutes learning the IEP before making their estimates. The provision of guidance to the observers chosen for the study was conducted within 48 hours of the first drinking event that they were designated to attend.

All observers -- guided and unguided -- received identical procedural information concerning the methods of the study. These instructions are attached in Appendix C. The methodological information consisted of a description of the purpose of studying social drinkers' cues of impairment, a brief explanation of the characteristics of the event, the procedures for registering a judgment, and an incentive to do the best possible job (and not compare judgments with the other group of observers). The observers were not told about differences in guidance, only that they are all competing for cash rewards for accuracy in their estimates.

The guided observers received an additional tutorial on how to use the Impairment Estimation Procedure. The brochure describing the cues also appears in Appendix D.

Observers

A total of sixteen observers took part in the evaluation of the IEP. Half were guided in use of the IEP while half estimated impairment without it.

Observer Categories

The types of observers selected for inclusion were balanced with respect to gender and role (e.g., server or host). Within each category, an observer was guided or unguided. This made 2^3 or eight combinations of observer types. With four assigned observers in attendance at each event, it took two events to provide all eight combinations an opportunity to observe. To get three replications for each observer required six events. To have a minimum of two different observers for each combination required twelve events.

One project staff scientist who had been involved in all the preliminary drinking studies also made impairment estimations.

In order to measure whether the observer can accurately judge the impairment levels of new drinkers, ones that they had not been observing for several hours, half of the drinking events conducted required observers to switch off from their assigned

drinkers to another batch of drinkers. This introduced a continuity of observation variable and provided some measure of whether the cues are useful guides for an observer who is abruptly assigned the task of making impairment estimates on an unfamiliar drinker.

The continuity variable was introduced in a way that split the observer assignments within each of the cells. That is, for twelve events, one observer within each cell observed continuously twice and interrupted once, while that observer's cellmate had one opportunity to observe continuously and two occasions to observe interrupted samples of drinkers.

With only eight observers falling into each experimental group (guided vs. unguided), the effect of guidance would have to be rather strong in order to attain statistical significance. With a fixed number of events, however, the number of subjects could have only been increased in one of the following two ways: (1) using *more observers per event*, which is too likely to have influenced the drinking behavior observed, or (2) reducing the *number of replications for each observer*, which would not have permitted any benefits of experience to be reflected in the accuracy of BAC estimates. It seemed best to keep the number of observers per event small and to allow observers to gain experience even if doing so limited the number of observers participating. If the results fell in a marginal range, it would always be possible to schedule additional observations in order to obtain a conclusive outcome. Meanwhile, the eight observers per category was sufficient to establish the physical significance of the impairment estimation procedure if it had a practically significant effect.

The same limitations apply to each of the stratification variables: gender, role, and continuity of observation. The effects would only become manifest if the variables had a strong effect. It should be noted that sample size was far too small to assess interactions of the stratification variables with the effect of the impairment estimation procedure.

BAC Measurement

The two devices used to measure BAC during the development of the IEP were used in its evaluation: the Intoxilyzer (infrared technology) and the SD2 (fuel-cell technology). More than one device was needed to allow for the recovery period between test administrations and still accommodate the rate of BAC measurement necessitated by the extent of drinking and number of subjects. While only the first of these two is an evidentiary breath tester, the correlation of .92 obtained between the readings of the two devices and the fact that they correlated equally with amount of alcohol consumed allowed them to be used interchangeably. Both devices appear on the National Highway Traffic Safety Administration's "qualified-products" list for use as evidential breath testers.

The use of passive sensors (e.g., semiconductor Tagucci cell technology) was discontinued during the IEP evaluation. Their primary purpose was to provide a reason for the BAC measurement that would be acceptable to subjects. Experience during the IEP development phase made it clear that this step was unnecessary; subjects accepted the fact that they were taking part in a scientific experiment and were willing to go along with the methods that were being employed. It became very apparent that their behavior was not inhibited by knowledge that they were being observed. Meanwhile, initiation of the performance to be described in the next section did not allow time for use of the passive sensors.

Performance Measures

In addition to blood alcohol, measures of observed performance were also used to assess impairment.

Role of Performance Measures

Measures of BAC provide a physiological measure of alcohol impairment. Because people differ markedly in their tolerance for alcohol, the correlation between BAC and impairment in the performance of many tasks, including driving, is far from perfect. Differences in tolerance could also help explain the lack of a close relationship between cues and measured BAC. Subjects with low tolerance might manifest cues of intoxication when their BAC shows them to fall only in the "moderately impaired" category. Conversely, subjects with high tolerance might exhibit no cues at all even though they are in the "moderately" or "severely impaired" categories. Because of differences in tolerance, cues that appear to be invalid measures of impairment because they bore a low relationship to measured BAC might turn out to be good indications of impairment as reflected by actual performance.

To gain better insight into the relationship between cues and impairment, measures of actual performance were included in the evaluation of IEP. These performance measures were not intended as an alternative criterion; BAC is the measure of impairment established under law for defining intoxication relative to operation of automobiles, aircraft, and boats, as well as other life activities. The inclusion of performance measures was intended only to better understand the relationship between cues and impairment, particularly instances where drivers evidenced high BACs but failed to manifest the corresponding cues.

Performance Measures Employed

Three tasks were examined as possible measures of performance:

- A cognitive task requiring quick recognition of irrelevant dimensions
- A motor control task involving threading a piece of monofilament through the eye of a needle
- A video driving game developed and marketed for home entertainment

All of these tasks proved unsuitable because of a strong learning effect which masked any performance degradation arising from the consumption of alcohol. Similar results were reported by Maylor and Rabbit (1987) in their study of the effects of practice on performance of computer game involving perceptual-motor tasks.

Instead of tasks that required learning, the effects of alcohol upon performance were assessed through the administration of two field sobriety tests used by police for estimating impairment among drivers stopped on suspicion of intoxication. The two tests used were (1) gaze nystagmus in each eye, and (2) a one leg stand. Performance was scored according to the protocol attached in Appendix E. Each time subjects reported back for a BAC measurement, one test technician administered the BAC test while another evaluated performance according to these field sobriety measures. A complete description of these performance scores follows in another section.

A sobriety performance index (SPI) based on gaze nystagmus and a one leg stand was combined into an alternate impairment scale. The possible total points (if added together) ranged from 0-9 each time a drinker was evaluated (3 points for each eye and 3 points for the leg). The measured impairment range in the drinking events covered the full range.

In order to form a scale, the results of these performance measures were treated in a fashion similar to the BAC data. As with BAC, the SPI index was divided into three impairment levels (1-3) ranging from slight to moderate to severe impairment. In order to assign a value of SPI to correspond to the clock time when a regular impairment judgment was made based on observed behavioral cues, the SPI values had to be interpolated. This resulted in the transformation of integer values of 0-9 into a continuous decimal scale.

Because, as with BAC, there were no natural inflection points in the continuous distribution of SPI scores, the interval break points were set equal on a percentile basis to the break points that characterized the distribution of impairment levels based on BAC. This resulted in approximately 50% slightly impaired, 35% moderately impaired, and 15% severely impaired according to the SPI. Such a step was justified on the basis of a highly significant correlation of .52 between BAC and SPI.

The SPI scale provided an alternate measure of impairment, one that is different from both the behaviorally observable cues and the measured BAC.

Other Procedural Changes

Other minor changes included assignment of code numbers to observers as well as drinkers so as to minimize evidence of their different role and adding more weight categories to the drinker history questionnaire. In addition, events were arranged so as to measure the likelihood of heavy drinking by actively soliciting heavier drinkers. Events were extended further into the night in order to increase the duration of observations and a designated driver program was implemented. The latter was added in order to allow one member of a couple to drive home after the event. To be eligible, the driver was kept below BAC .04%. Periodic monitoring of BAC was done to assure compliance.

Making the Impairment Judgments from Behavioral Cues

The observers were asked to make an impairment estimate for each of their assignees every thirty minutes through the duration of the event. An observer watching five drinkers at a time after four hours of drinking could have made forty estimates. Over twelve drinking events with four observers present and approximately twenty drinkers per event the process would yield about (12x4x40) or 1920 estimates. The actual number of drinkers was typically higher than twenty, though never more than thirty-six, requiring that each observer track five to nine drinkers. Accordingly, the number of data points was higher than that expected.

The report format required that the observers note the drinker's ID number, observation time (preprinted on a different card representing each half hour between 8 and 12), a grid in which to check the appropriate impairment level, and a space to note any relevant behavior. While assessing individual cues was not a part of this study phase, guided observers were also asked to note which of the cues were the most useful to them in making their judgments.

Appendix C contains the explanation given to the observers for the studies, the instructions for making judgments, the incentive system devised to encourage their independence of judgment. The cue tutorial given the guided observers is appended separately.

RESULTS

The results reported here are divided into 3 sections. These include the following:

- Sample characteristics
- The effectiveness of IEP in estimating BAC
- Individual cues

Sample Characteristics

Twelve drinking events were conducted in the Washington DC metropolitan area between mid March and late July, 1989. A total of 2,767 observations were made on 333 drinkers by 16 observers selected and assigned on the basis of the primary stratifying variables of gender, normal role (social host or professional server), and presence or absence of guidance. A 17th observer was the project senior scientist who provided the guidance orientation and was present at all events in the role of overseer. Results reported represent only the judgments of the 16 experimental observers unless otherwise noted.

Observer Characteristics

This section describes the characteristics of the observer. The sixteen observers ranged in age from 21 to 53 years of age, half were male, thirteen white, three black. Mean ages by observer category are given below.

Category	Age
Guided	30.2
Unguided	32.5
Server	28.9
Host	33.9
Male	30.7
Female	32.0

Drinker Characteristics

While no claim can be made about the representativeness of observers due to the small numbers, drinkers represented a broad cross-section of alcohol-consuming adults in a large metropolitan area.

Demographics

The age breakdown of drinkers appears below. Fifty-three percent of the drinkers were between 21 and 30 years of age, four percent were over 61 years, other age decades fell between these extremes.

Age Group	Frequency	Percent
21-30	175	52.6
31-40	65	19.5
41-50	49	14.7
51-60	23	6.9
Over 61	12	3.6
Missing	9	2.7

Fifty-five percent of the drinkers were male. Although no data document the socioeconomic status of the drinkers, it was apparent that participants ranged from lower middle to upper middle class. The drinking events were exclusively white, exclusively black, or of mixed race.

Amount of Drinking

The majority (92%) of the drinkers complied with the request to arrive without having consumed any alcohol. Of the twenty-six individuals who were above a BAC of zero at baseline, sixteen were not impaired (BAC<.04%), four were influenced (BAC=.04-.08%), and five were intoxicated (BAC>.08%).

Across all drinkers, the average growth of the interpolated BAC curve, adjusted to begin at their time of arrival (designated drivers included), is shown in Figure 3 for all 333 drinkers. Both mean and standard error are displayed at thirty minute intervals.

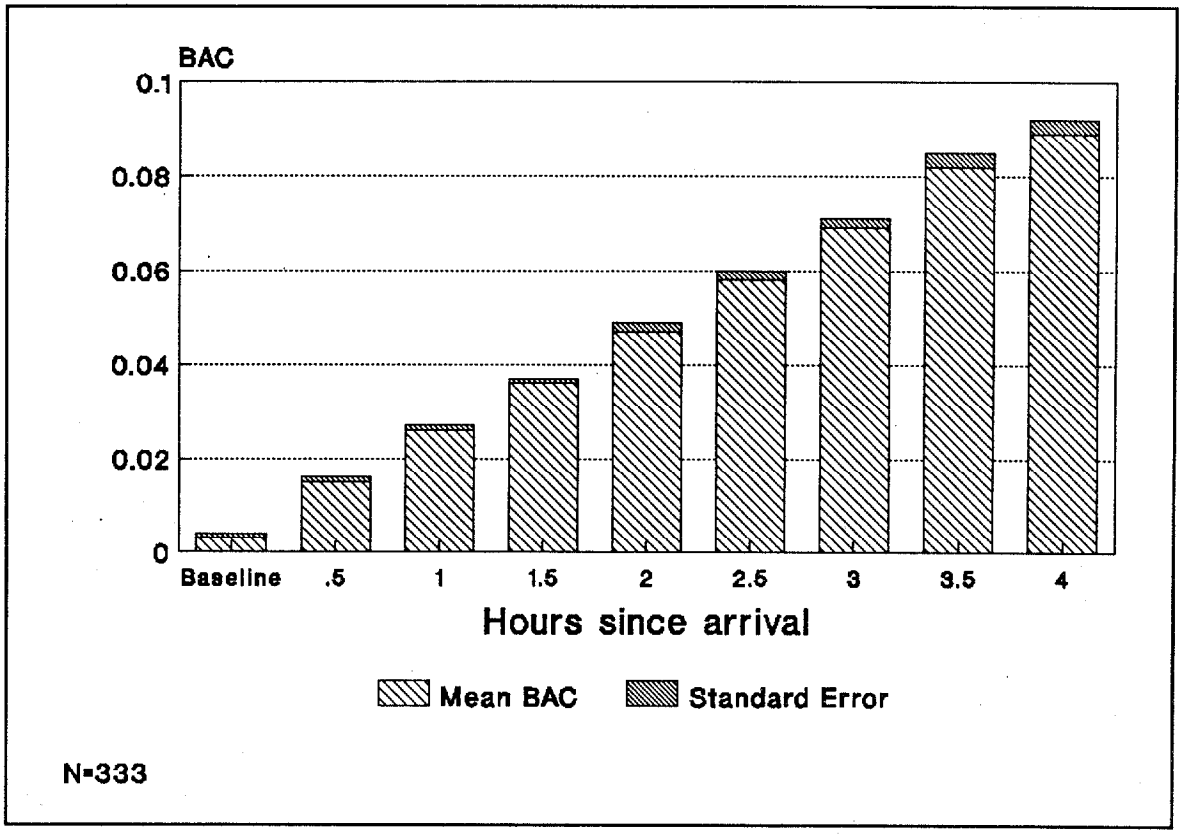
Drinking History

The majority of participants were beer drinkers, sixty-one percent reported beer to be their alcohol beverage of choice. Twenty six percent favored distilled spirits, while eleven percent favored wine (clearly not a California crowd).

Each drinker was asked four questions about their typical patterns of consumption. Questions concerned their *usual* frequency and amount of drinking and their *unusual* or extreme amount and frequency of consumption.

Figure 3

Mean BAC by Hours Following Arrival at Drinking Event



The mean and modal frequency of consumption of the drinker's preferred beverage was reported to be twice a week. The modal quantity of alcohol consumed in one setting on a regular basis was two or three drink equivalents (mean = four drinks). When drinkers consumed more than their usual amount, the modal report was six drink equivalents (mean = seven drinks). When asked how often they drank more than their usual amount, the modal response was three or four times per year (mean = once per month).

The Effectiveness of IEP in Estimating BAC

A measure of the overall effectiveness of the IEP in improving estimation of BAC can be gained by comparing the accuracy of BAC estimates with and without guidance from the IEP. An Analysis of Variance showed that judged impairment level accounted for 45.5% of BAC variance among raters guided by the IEP and 36.9% of variance among those not receiving such guidance. This corresponds to correlations between estimated impairment level and true BAC of .674 and .607 respectively for guided and unguided raters.

Table 4
Percent Correct Estimates of Impairment Level by Guidance

	IMPAIRMENT LEVEL		
	Slight	Moderate	Severe
Not Guided (N=1420)			
Correct Estimates	73.1	49.9	50.0
Chance	52.6	28.2	19.2
Difference from Chance	**20.5**	**21.7**	**30.8**
Guided (N=1347)			
Correct Estimates	75.7	61.3	49.3
Chance	54.7	24.9	20.3
Difference from Chance	**21.0**	**36.4**	**29.0**
Guidance Difference	+0.5	+14.7	-1.8
Relative Improvement (%)	2.4	67.8	-5.8

While a correlation coefficient describes the general relationship between impairment estimates and BAC, a more informative measure of success in properly categorizing impairment level is the percent of occasions in which raters correctly estimated impairment level. This is summarized in Table 4. The success rate for guided and unguided raters is shown within each impairment level. The percentage of actual correct judgments and, for comparison, the chance percentage are also provided. A difference between the two guidance conditions and a percent improvement score are shown.

Chance performance is defined, for the purposes of this report, as the outcome of a random attribution of impairment judgments based on the proportional representation of impairment that observers within a guidance level were exposed to. For example, if 40% of drinkers are actually intoxicated (i.e., "severely impaired") and 30% are estimated to be intoxicated, we would expect 40% of 30% or 12% of intoxicated drinkers to be correctly identified by chance alone. The table subtracts that chance performance from observed performance so that a more direct comparison can be made between the guided and unguided observers.

The judgments made by the guided observers were more accurate than those of the non-guided when the drinkers were moderately impaired. Use of the IEP in this case resulted in a 68% improvement in the proportion correct (14.7 ÷ 21.7) relative to the not guided. Differences in accuracy of judgment among the slightly impaired or

severely impaired group was negligible. That guidance was most effective in the moderately impaired range is not surprising. The procedure would be of little value when there is no real impairment to estimate, nor when it is great enough to be obvious.

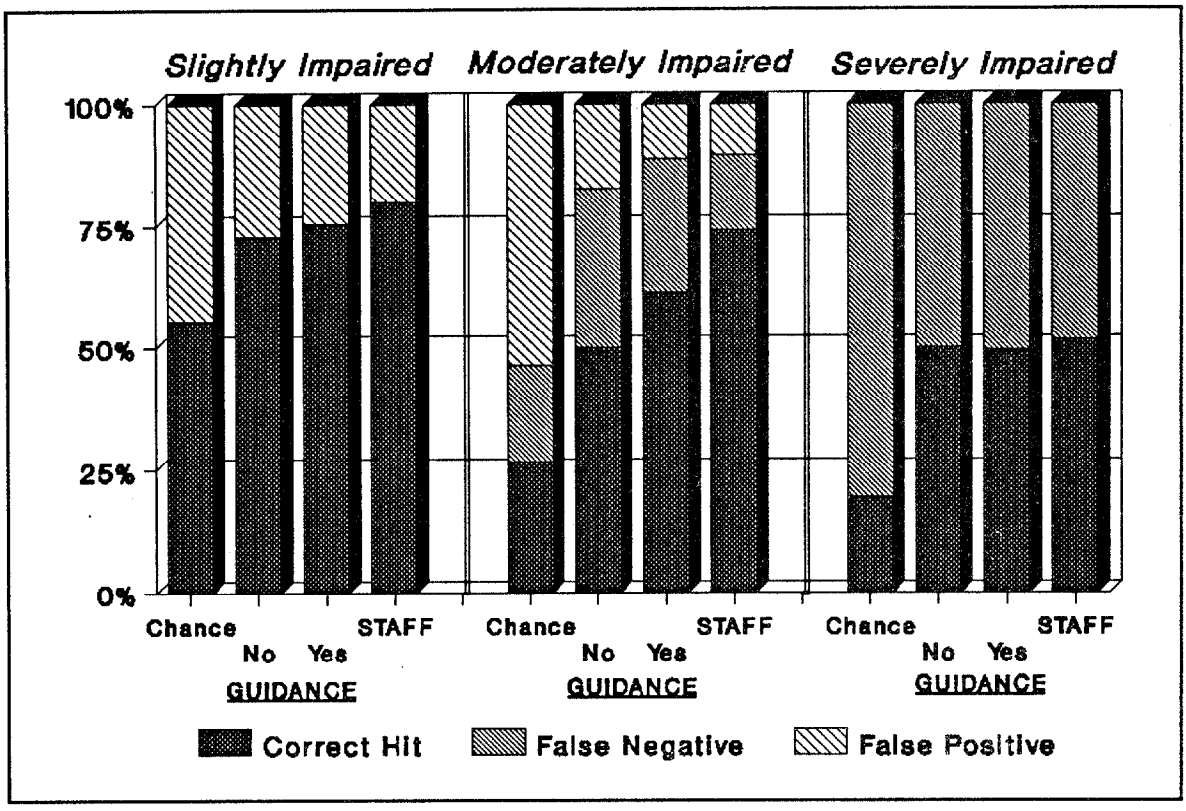
The percent correct estimates of BAC for drinkers at each of the three impairment levels is shown graphically in Figure 4. The figure also shows the type of error as well as the levels of accuracy that might be expected by chance and that achieved by the project staff member. An error in judgment when a drinker is "slightly impaired" is a false positive; an error when a drinker is "severely impaired" is a false negative. When "moderately impaired", either error is possible. Again, we see that the only noteworthy differences occurred when drinkers were in the "moderately impaired" category. While all groups did better than chance, those guided by the IEP were more accurate than those making judgments without use of the IEP.

False negatives -- labeling drinkers as only slightly impaired when they were, in fact, moderately impaired -- are more serious than false positives -- labeling them as more impaired than they were. Here we can see that those employing the IEP had far fewer errors than those not using it.

A significance test was performed by comparing the accuracy of the eight guided and unguided observers with respect to the percent of estimates that were correct. The significance test was confined to those estimates made when drinkers were in the Moderate Impairment category as these were the only observations showing differences between the two groups of observers. The significance test involved a factorial analysis of variance in which the dependent variable was the percent of the observers' estimates that were correct and factors were Guidance, Role, Gender, and Continuity. The results showed the effect of guidance by the IEP to be statistically non-significant ($F=1.05$, $p=.34$) with only eight observers in each group being compared.

With only eight observers falling into each experimental group (guided vs. unguided), the effect of guidance would have to be rather strong in order to attain statistical significance. With a fixed number of events, however, the number of observers could have only been increased by: (1) using *more observers per event*, which is too likely to have influenced the drinking behavior observed, or (2) reducing the *number of replications* for each observer, which would not have permitted any benefits of experience to be reflected in the accuracy of BAC estimates. It seemed best to keep the number of observers per event small and to allow observers to gain experience even if doing so limited the number of observers participating.

Figure 4
Percent Correct BAC Estimates and Type of Error by Guidance and Level of Impairment



Were one willing to assume that the various observations were independent of one another and use the observation rather than the observer as the unit of analysis, the effect of guidance would be highly significant ($F=8.62$, $p<.01$). If the observers could be considered purely objective reporters and each observation a reflection of drinker behavior, then it would be legitimate to treat the observations as the unit of analysis. However, to the extent that observers differ from one another in their perceptiveness, the observations would lack independence and the sample size would be equal to the number of observers rather than the number of observations. A reasonably cautious interpretation of the data would be that the IEP appears to be effective in improving estimates of impairment, as measured by BAC, but that effectiveness has certainly not yet been proven.

Controlling for Tolerance

One variable that might have weakened the relationship between estimated and measured BACs was tolerance for alcohol. Many of the false negatives involved drinkers who attained very high BACs without manifesting any of the cues that were

associated with those BACs among other drinkers. Some portion of these high BAC drinkers may have had an abnormally high tolerance for alcohol and were not actually impaired except in a legal sense. It is possible that the IEP gave a better indication of impairment than did their BAC level.

One way of examining the effect of differences in tolerance upon estimated BAC is to examine the relationship between estimated and actual impairment while controlling for differences in tolerance. A measure of tolerance was obtained for drinkers by the use of the sobriety tests. Specifically, the BAC estimated from their sobriety tests was subtracted from their actual BAC and averaged (with regard to sign) across all observations for a given drinker.

Those with high positive values (i.e., actual BAC generally was higher than sobriety tests would indicate) had high tolerance while those with high negative values (actual BAC was generally lower than sobriety tests would indicate) had low tolerance. The relationship of cue-estimated BAC to actual BAC was determined by using analysis of variance (ANOVA) with and without tolerance as a covariate. With control for tolerance, the proportion of variance for BAC accounted for by the IEP rose from 45.4% (r=.67) to 52.5% (r=.73) for the guided subjects. The effect of controlling for tolerance is much greater for the sub-sample judged to be moderately or seriously impaired. Within this restricted group, controlling for tolerance raised the proportion of BAC variance accounted for from 9.1% (r=.30) to 16.7% (r=.41).

The analysis just described assumes that BAC is the true measure of impairment. However, one could easily defend performance on the sobriety tests as the better measure of true impairment. One way of side-stepping this issue is to confine the analysis to those instances when the two measures of impairment (sobriety tests and BAC) agreed. To do this, an additional analysis was performed using only those observations made when the BAC and the sobriety performance index (SPI), described earlier, placed the drinker in the same category. This process eliminated from the sample those drinkers who had particularly high tolerance (high BAC and low performance decrement) or particularly low tolerance (low BAC, high performance decrement). Since the sobriety tests were only obtained in the last eight events, the number of observers per group was reduced from eight to six.

Table 5 shows the percent of correct judgments for those guided and not guided by the IEP.

Controlling for tolerance increased the percent correct estimates among those guided by the IEP (refer to Table 4) from 61% to 72%, while the correct estimates of unguided observers remained largely the same (50% vs. 51%).

Table 5
Percent Correct Estimates of Impairment Level by Guidance: Using BAC and Performance to Measure Impairment

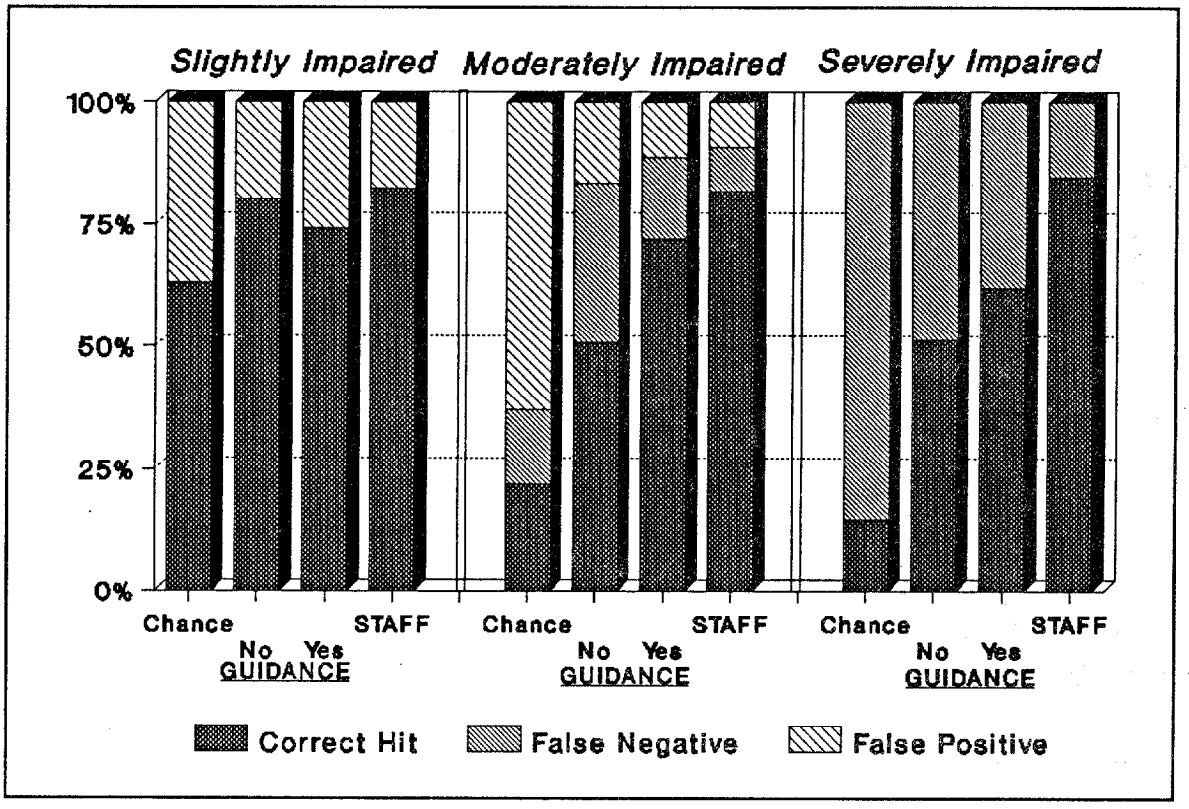
	IMPAIRMENT LEVEL (Slight	Moderate	Severe)
Not Guided (N=594)			
Correct Estimates	80.2	50.8	51.3
Chance	64.6	22.2	13.1
Difference from Chance	**15.6**	**28.6**	**38.2**
Guided (N=404)			
Correct Estimates	74.2	71.9	61.9
Chance	62.4	22.0	15.6
Difference from Chance	**11.8**	**49.9**	**46.3**
Guidance Difference	-3.8	+21.3	+8.1
Relative Improvement (%)	-24.4	+74.5	+21.2

The results obtained when the sample of observations was confined to those in which the blood alcohol level and sobriety tests agreed were subject to an analysis of variance in the same manner described earlier. The Analysis of Variance (ANOVA) showed a significant guidance effect ($F=8.37$, $p<.05$). Thus, even though the number of observations upon which the accuracy of observers was judged dropped by almost two thirds, improved accuracy with which true impairment was estimated resulted in a significant guidance effect.

Figure 5 presents results graphically, again including those obtained by the member of the project staff. Within the Moderate Impairment category, not only is the proportion of correct estimates attributable to guidance markedly increased, but, in the critical false negatives category, the errors committed by the Guided observers are less than half those for the unguided observers.

It is worth noting that the estimates of impairment provided by the member of the project staff in attendance were somewhat more accurate than those of the observers, particularly when the effects of tolerance were controlled by taking the sobriety tests into account. In the case of false negatives, the errors of the staff member were half those of the guided observers. Obviously it would be inappropriate

Figure 5
Percent Correct BAC and Performance Estimates and Type of Error
by Guidance and Level of Impairment



to generalize from the results of a single staff observer. They may, however, provide an estimate of the accuracy of the impairment estimation procedure itself, without regard to the effectiveness of the guidance through which the procedure was communicated to the observers. It suggests that slight increases in accuracy of impairment estimation might be achieved with somewhat better guidance.

It may be of interest to note that the tolerance measure evidenced small but significant correlations, ranging between .24 and .31, with the four drink history questionnaires. All of the correlations were in the expected direction, with the drinkers having the heaviest history of drinking showing the greatest tolerance. A combined history index generated from all four questions correlated .36 with the tolerance measure.

The significant effect of tolerance on accuracy of IEP estimates indicates that it is a true drinker characteristic and not just a random variation in the generally linear relationship between sobriety tests and BAC measures. To test the stability of the tolerance variable, an ANOVA was conducted to obtain the intra-class correlation of tolerance measures over time, that is, the correlation of tolerance measures for all possible pairs of the four measures taken on the same drinker. The intra-class correlation of .42 was statistically significant ($F=2.36$, $p=.001$). While there is a good deal of variation in tolerance over time, it is clear that the measure amounts to something more than a random variable.

Categories of Observers

The mean performances overall of the non-guided and guided observers broken down by gender, role, and continual observance of the drinkers vs. interval observations are shown in Table 6.

Table 6
Proportion Correct Estimates of Impairment Level by Gender, Role and Continuity

	Not Guided	Guided
Continuous	.6230	.6751
Interrupted	.6194	.6581
Female	.5724	.6465
Male	.6555	.6907
Server	.6494	.6835
Host	.5939	.6540

It is evident that the differences between observer categories are very small; none even approached statistical significance. The only reason for placing any confidence at all in the obtained differences is that they are in the expected direction, with the greatest accuracy being achieved by those presumably having the greatest long term or immediate exposure to impairment: males were slightly more accurate than females, servers were slightly more accurate than social hosts, and those who had an opportunity to view drinkers continually were slightly more accurate than those whose observations were interrupted. However, the similarities among the different categories of observers are more impressive than the differences.

Individual Cues

The objective in evaluating the Impairment Estimation Procedure was to ascertain the validity of the process as a whole, not to assess individual clues. However, those observers who were using the IEP were asked to note on their checklists which cues they noted in estimating the impairment of a particular subject. The mean BACs corresponding to the observations are shown in Table 7, along with the mean BACs for the same cues as obtained during the cue assessment phase. Because of a procedural

Table 7
Mean BACs of Cues during the Cue Assessment and IEP Validation Phases

CUE	CUE ASSESSMENT	IEP PHASE
Moderate Impairment		
Physical	.065	.074
Loud	.065	.064
Uninhibited	.053	.067
Close	.047	.072
Rude	.068	.075
Red-Eyed	.058	.076
Warm	.059	.055
Silly	.057	.057
At Ease	.053	.067
Slouching	.054	.056
Deliberate	.066	.061
Severe Impairment		
Uncontrolled	.071	.074
Hostility	.081	.080
Sloppy	.069	.081
Stumbling	.078	.088
Poor Perception	.076	.072
Slurring	.073	.095
Fumbling	.077	.099
Six or More Cues		.085

Because of a procedural problem mean BACs could not be obtained in four cues: expansive, convivial, withdrawn, and confused.

It is noteworthy that the BAC levels are generally higher than those shown earlier in Table 1. Two factors contributed to this increase:

- The encouragement to greater drinking and the generally higher BACs found in the IEP evaluation.

- The fact that cues and impairment estimates were offered at half-hour intervals rather than at the precise moment they were observed, with BACs rising slightly during the interim.

On the whole, the cue-BAC relationships observed during the earlier cue assessment were found again in the IEP evaluation. All of the mean BACs over .08% were associated with cues in the "Severely Impaired" category and all of the cues with mean BACs less than .07% fell in the "Moderately Impaired" category. There was some overlap among cues having mean BACs in the .07% range. The "borderline" cues were largely those falling in that same category during the cue assessment phase.

Two additional cues emerged from the IEP evaluation study. One involved "uncoordinated" behavior, evident in poor dexterity when attempting to write or pick up small objects, which was observed on nineteen occasion with a mean BAC of .070% and a standard deviation of .031%. This cue of "Moderate" impairment was distinguished from the shaky, spastic "fumbling" behavior which characterizes "Severe" impairment and was associated with a mean BAC of .099% and a standard deviation of .030% during the IEP evaluation. The addition of these cues and the "six or more of the above" cue raised the total to 24 cues.

The second cue involved use of strong profanity, typically involving sexual references, which was observed on nine occasions with a mean BAC of .084% and a standard deviation of .045%. This rather well-known cue of intoxication had been observed during the cue assessment phase but less than four times. These two cues have been added to the final version of the Impairment Estimation Procedure.

DISCUSSION

The study described in this report involved the highly systematic development and assessment of a procedure for estimating alcohol impairment from visible cues. A comprehensive search for candidate cues made use of published literature and ratings by researchers whose work permitted the observation of drinkers having known levels of alcohol impairment.

Candidate cues were subject to empirical assessment through a series of social drinking events in which observations of cues were recorded and compared with measures of blood alcohol levels. Those cues that were observed frequently enough to be of practical use and to provide reliable estimates of cue-BAC relationships were examined for their accuracy in estimating blood alcohol levels. Some 24 cues meeting the criteria of frequency and accuracy were fashioned into an Impairment Estimation Procedure (IEP).

The Impairment Estimation Procedure was evaluated through a series of twelve social drinking events in which observers classified drinkers into three impairment categories: *Slightly Impaired*, corresponding to a BAC of .00-.04%, *Moderately Impaired*, corresponding to BACs of .04-.08%, and *Severely Impaired*, corresponding to BACs in excess of .08%. Sixteen observers participated in the assessment, half of them were guided by the IEP and half were not.

The IEP and Measured Impairment

All observers -- guided and unguided -- did markedly better than chance in assigning drinkers to the three categories. Use of the IEP was of apparent advantage only for those drinkers who fell in the "Moderately Impaired" category. The advantage was particularly great with respect to false negatives, where the proportion of moderately impaired drinkers classified as only slightly impaired by those using the IEP was only half the proportion similarly so misclassified by observers not using the IEP. A statistically significant difference between the two categories of observers only prevailed when the study sample was limited to drinkers who were classified in the same category by both blood alcohol measures and measures of performance using field sobriety tests.

It is not surprising that the cues did a better job of estimating impairment when the measure of impairment included performance than when it was based on blood alcohol level alone. Most of the cues themselves involved performance. If eye movement or the ability to stand on one leg are unaffected by alcohol, it may be optimistic to expect to see change in social behavior.

If the objective of the IEP was to estimate the extent to which performance is impaired by alcohol, then the procedure has achieved some degree of success. Drinkers placed in the moderately impaired zone by BAC and sobriety test were correctly classified 72% of the time by observers using the IEP as opposed to 51% by the unguided observers. That is a 41% difference. Some proportion of the correct identifications by each group would have occurred by chance. If one examines improvement over chance, the effects of the IEP are even more impressive - those guided by the procedure showing a 50% improvement over chance versus a 29%

improvement for those not using the procedure. That amounts to a 1.7 to 1 difference ratio.

Of the two types of errors one can make, overestimating versus underestimating impairment, the latter would have the most adverse consequences. Among drinkers who were in the marginal "moderately impaired" category, the unguided observers underestimated impairment 34% of the time versus 17% for the guided observers. In other words, the guided observers misidentified a drinker who was moderately impaired as being only slightly impaired only half as often as did the unguided observers.

Among the drinkers who were severely impaired (i.e., BAC>.08%), the differences between guided and unguided observers were smaller and non-significant. Apparently, severe impairment is sufficiently obvious that the IEP is not necessary. Nevertheless, the differences found were in the expected direction, with 49% false negatives among the unguided observers versus 38% among the guided observers.

The IEP and Blood Alcohol Concentration

While the ability to estimate impairment of performance may be of greater value in the prevention of injury than is the ability to estimate blood alcohol level, the latter is far from unimportant. Anyone whose BAC exceeds .08% or .10% (depending upon the jurisdiction involved) meets the legal definition of "intoxication," with respect to operation of an automobile, aircraft, or watercraft. Any host or server who contributes to someone's intoxication places that person in jeopardy of arrest and possible liability for any accident, regardless of their performance impairment. Although the benefit of the IEP in estimating blood alcohol level could not be statistically established, the small number of observers did not provide a conclusive test. A more ambitious evaluation of the procedure in both private homes and licensed establishments is soon to be undertaken. The results of the present study, if not conclusive, are at least encouraging.

Level of Guidance

The comparison of observations with and without use of the IEP provides an assessment not of the procedure itself, but of the guidance by which it is communicated and the receptiveness of the observers themselves. To the extent that the observers and the guidance are representative of what would prevail when the procedure is put to actual use, the results that have been described yield the best available estimate of the true utility of the procedure.

In order to make the guidance as useful as possible, it was kept as brief as possible. Brevity is particularly important in the case of social hosts, who are unlikely to make use of any procedure that required extensive reading, let alone a formal

training program. However, among servers of alcohol, more extensive preparation, including participation and training, is quite feasible. More and more licensed establishments are providing instruction in impairment estimation to their employees, either as part of their regular post-employment orientation and training or through special courses in responsible alcohol service.

What might have happened had observers been given more extensive preparation in use of the impairment estimation procedure? While this question cannot be answered with confidence, the results obtained by the project staff representatives provide some indication of the additional degree of accuracy in estimating impairment that might be achieved with greater preparation. In a sense, it provides a glimpse of the validity of the IEP itself. In estimations of impairment, the project staff member evidenced greater accuracy than observers using the procedure. The difference between the staff member and the observers was somewhat greater among severely impaired drinkers than those who were moderately impaired. While no statistical significance can be attached to this outcome, it suggests that more extensive preparation of observers might lead to even greater accuracy in estimating impairment.

Any additional guidance and preparation need not replace the simple handout provided to the observers in the present study. Rather, two levels of guidance might be provided: a brief instructional program for inclusion in server training and presentation to others willing to participate in it, and the handout for those who cannot be reached through an instructional program.

As a means of providing more extensive instruction, a ten-minute video was prepared. Live action video was obviously better suited to communicating visible cues of alcohol impairment than is the written word. Most of the scenes were taken from available video footage used in videos prepared for server and host intervention instructional programs. A copy of the script appears in Appendix F.

Additional Research

The purpose of the project that has been described was to develop and assess a procedure for estimating alcohol impairment from cues observable in a social setting. The product of the effort was to be a guide to assist hosts and servers in detecting impaired guests. The next step in the process will be to evaluate the effectiveness of the Impairment Estimation Procedure guidance in enabling servers and hosts to spot alcohol impaired guests. Originally, a single guide was envisioned. However, with discernable categories of users, and evidence that different levels of guidance may produce different levels of accuracy in estimating impairment, it would seem advisable to expand the evaluation to assess each level of guidance separately.

CONCLUSIONS

From the study that has been described in this report, the following conclusions may be reached:

1. Certain readily available cues of physical appearance, motor control, and social behavior are associated with sufficiently limited ranges of blood alcohol level as to provide useful cues to alcohol impairment.

2. A simple, easily learned impairment procedure based upon the scale of qualities of selected cues improves the ability of observers to detect true impairment, that is, impairment that is manifest both through blood alcohol levels and performance on sobriety tests.

3. The advantage of the impairment estimation procedure is largely confined to drinkers who are in the BAC range of .04-.08% - and mid-range on sobriety tests.

4. The success of the IEP in identifying impairment levels comes primarily from reducing the numbers of false negatives, that is, it helps identify moderately impaired drinkers that might be misidentified as not impaired.

5. The best available estimate of improvement in detection of moderate impairment is a 38% increase in correct estimates, with the number of false negatives being reduced by half.

6. It is possible that more extensive preparation might yield slight increases in the effectiveness of the impairment estimation procedure.

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APPENDIX A

Cue Number	CUES	Report. BAC lev.	Obs. Freq. (SIP)	Focus Group		Expert Ratings		
				Mention	Accept	Val.	Rel.	Freq.
1	Physical							
1.1	Objective							
1.1.1	Face					3.50	3.00	3.50
1.1.1.1	Flushed			X		2.25	2.00	2.50
1.1.1.2	Sweating			X		2.00	1.25	1.25
1.1.1.3	Drooling from mouth			X		1.50	1.25	1.00
1.1.1.4	Nose running, sniffing			X		1.00	1.00	1.00
1.1.2	Eyes					4.00	3.50	3.50
1.1.2.1	Red		16.3			2.75	2.25	2.50
1.1.2.2	Glassy		11.1		X	3.25	2.50	3.00
1.1.2.3	Gaze					3.67	3.67	3.67
1.1.2.3.1	Crossed				1	1.75	1.25	1.25
1.1.2.3.2	Tracking object					4.25	3.25	3.50
1.1.2.3.3	Non-focused (Trance-like)		14.7		X	3.25	2.50	2.75
1.1.2.4	Closed (dozing)					3.25	2.25	3.00
1.1.2.5	Blinking		2.0			2.50	2.00	2.25
1.1.2.6	Bleary				1	3.00	2.50	3.00
1.1.2.7	Pupils dilated			X		2.00	1.50	1.50
1.1.2.8	Watering					2.00	1.75	2.00
1.1.3	Hands					2.33	1.67	2.00
1.1.3.1	Shaking				X	2.00	1.50	1.75
1.1.4	Hair					1.67	1.00	1.33
1.1.4.1	Disheveled					1.50	1.00	1.00
1.1.5	Clothes					1.67	1.00	1.33
1.1.5.1	Mussed, shirt untucked			X		2.00	1.00	1.25
1.1.5.2	Loosening		3.6	X		1.75	1.00	1.25
1.1.5.3	Taking off		2.8		X	1.75	1.75	2.00
1.1.6	Breathing					2.00	1.33	1.33
1.1.6.1	Slow or shallow				X	2.00	1.50	1.75
1.1.7	Body tremors/shaking		.8		1	2.75	2.00	2.25
1.1.8	Hearing				1	2.50	1.50	2.25
1.1.9	Smell of alcohol			X		3.00	2.00	3.25
1.2	Subjective							
1.2.1	Temperature					1.67	1.33	1.00
1.2.1.1	Warm	.05-.09			X	1.50	1.25	1.00
1.2.1.2	Cold (putting extra clothes on)			X		1.50	1.25	1.50
1.2.2	Sensation				2	2.67	2.00	3.00
1.2.2.1	Headache				2	2.75	1.75	2.00
1.2.2.2	Numb				2	2.75	2.00	2.00
1.2.2.3	Tired, fatigue	.08	5.6		2	2.75	1.25	2.75
1.2.2.4	Eyelids heavy, sleepy, drowsy	.20		X	2	3.00	2.00	3.25
1.2.2.5	Dizzy	.20-.30		X	2	3.00	2.25	2.75
1.2.2.6	Nauseous	.20-.30	.4	X	2	3.25	2.50	3.00
1.2.2.7	Mouth dry				2	2.25	1.75	1.50
1.2.3	Vision					2.33	2.33	2.00
1.2.3.1	Poor				X	2.25	2.00	1.75
1.2.3.2	Double	.20			X	2.75	2.25	2.00
1.2.4	Awareness				1	3.00	2.33	2.33
1.2.4.1	Acknowledges intoxication		7.5			3.25	2.75	2.50
2	Perception							
2.1	Objective							
2.1.1	Distance judgment					2.75	2.25	2.25

Cue Number	CUES	Report. BAC lev.	Obs. Freq. (SIP)	Focus Group		Expert Ratings		
				Mention	Accept	Val.	Rel.	Freq.
2.1.1.1	Can't light cigarette		4.4		X	3.00	2.50	2.75
2.1.1.2	Knocks things over, spills	.2	11.1		X	3.00	2.25	2.75
2.1.1.3	Bumps into things		7.5		X	3.25	2.25	2.75
2.1.1.4	Misses mouth with glass				X	3.00	2.50	2.75
2.1.1.5	Misses ashtray		2.0		3	3.00	2.25	2.75
2.1.1.6	Misses objects reached for				1	3.25	2.50	3.00
2.1.1.7	Sets things down hard (e.g., glass)		5.2		3	2.75	1.75	2.50
2.1.1.8	Misses chair (sits too hard or misses)			1		3.00	2.50	3.00
2.1.1.9	Sets things down at angle		.4		1	2.75	1.75	2.25
2.1.2	Recognition	.30				3.50	2.50	3.00
2.1.2.1	Mistakes objects as own					2.50	2.25	2.50
2.1.2.2	Mistakes people				X	2.25	2.25	2.25
2.1.3	Decreased time perception				1	3.00	2.50	2.25
2.1.4	Increased reaction time	.05-.09 .01			1	4.00	3.00	3.25
2.2	Subjective							
2.2.1	Complains about distance judgment					2.25	1.25	1.25
2.2.2	Complains about recognition					2.00	1.25	1.25
3	Cognitive							
3.1	Objective							
3.1.1	Confusion	.15-.20				3.33	2.33	2.67
3.1.1.1	Mistakes people				X	2.75	2.00	2.00
3.1.1.2	Loses track of people				X	2.75	2.25	2.25
3.1.1.3	Mistakes money					3.00	2.00	2.25
3.1.1.4	Mistakes drinks		.8			2.75	2.00	2.25
3.1.1.5	Mistakes other objects					2.50	1.50	1.75
3.1.2	Disoriented					4.00	3.00	4.00
3.1.2.1	Time	.10-.20 .35				4.50	3.50	3.50
3.1.2.1.1	Confuses events				X	3.25	2.00	2.25
3.1.2.1.2	Loses track of time/date			X		3.25	2.50	2.25
3.1.2.2	Place	.15-.20 .20-.30 .35				4.00	3.00	3.00
3.1.2.2.1	Confuses current location				X	3.00	2.25	2.25
3.1.2.2.2	Confuses home, workplace, etc.					2.75	2.25	2.25
3.1.3	Attention span, concentration	.08		X		4.50	3.50	4.00
3.1.3.1	Changes topic, rambles					3.75	2.75	2.75
3.1.3.2	Doesn't follow conversation, events		2.0	X		3.75	3.00	3.00
3.1.3.3	Unable to do 2 things simultaneously					4.25	3.75	4.25
3.1.3.4	Inattentive	.20-.30			X	4.00	3.25	3.75
3.1.4	Information Processing/Comprehension	.01			1	4.00	4.00	4.00
3.1.4.1	Loses train of thought			X		3.75	3.75	3.25
3.1.4.2	Repetition of commands/conversation				1	4.00	3.25	3.25
3.1.5	Decision making				1	5.00	4.00	4.00
3.1.5.1	Slow to respond				X	4.00	3.50	3.75
3.1.6	Memory					3.50	3.00	3.00
3.1.6.1	Forgets earlier events (to pay bill)			X		3.00	2.50	2.25
3.1.6.2	Loses items		2.0		X	2.75	2.25	2.25
3.1.6.3	Forgets items (Gets food, doesn't eat)					2.75	2.25	1.75
3.1.6.4	Forgets own acts (lights 2 cigarettes)		2.4		X	2.75	2.75	2.25

Cue Number	CUES	Report. BAC lev.	Obs. Freq. (SIP)	Focus Group		Expert Ratings		
				Mention	Accept	Val.	Rel.	Freq.
3.1.6.5	Forgets to light cigarette		2.4			2.50	2.25	2.25
3.1.6.6	Repeats conversation					3.50	3.00	2.75
3.1.6.7	Repetitive action					3.25	2.75	3.00
3.1.6.8	Gets lost		.4			3.25	2.75	2.75
3.1.7	Careless with money					3.00	2.33	2.67
3.2	Subjective							
3.2.1	Complains of confusion					2.50	1.75	2.25
3.2.2	Complains of disorientation: time					2.50	2.25	1.75
3.2.3	Complains of disorientation: place					2.50	2.25	1.75
3.2.4	Complains of attention lapses					3.00	2.50	2.00
3.2.5	Complains of memory loss					3.00	2.25	2.00
4	Affective							
4.1	Objective							
4.1.1	Nervousness					2.67	2.33	2.33
4.1.1.1	Chain smokes		13.1		X	2.75	2.50	2.50
4.1.1.2	Fidgety/restless		2.8	X	X	2.50	2.25	2.50
4.1.1.3	Hyperactive, agitated	.05-.15			1	2.25	2.00	2.25
4.1.2	Mood	.20				3.00	2.67	2.33
4.1.2.1	Despondent, crying	.05-.09 .08	5.6	X		3.00	2.75	2.50
4.1.2.2	Tranquil/sedated	.05		X		3.25	2.50	2.75
4.1.2.3	Elated, euphoric, exhilarated	.05-.09 .03-.05	29.8		3	3.25	2.50	3.00
4.1.2.4	Rapid changes in mood			X		3.00	2.25	2.75
4.1.2.5	Hostile					3.00	2.50	2.75
4.1.2.6	Distracted, oblivious				X	3.25	2.25	2.50
4.1.2.7	Lack of feeling, apathetic (indifferent)				X	2.50	1.75	1.50
4.1.2.8	Inappropriate mood(laugh wrong time]			X		3.00	2.00	2.00
4.1.2.9	Relaxed	.05-.09 .01			X	3.00	3.00	2.50
4.1.2.10	Exaggeration of emotion	.05-.09			X	3.25	2.75	2.50
4.1.2.11	Irresponsible				1	2.67	2.33	2.67
4.1.3	Confidence			X		3.00	2.33	2.67
4.1.3.1	Unsure	.20-.30			X	2.75	2.00	1.75
4.1.3.2	Confident, taking dares	.05		X		3.25	2.75	3.00
1.4.1	Withdrawn, alone					3.25	2.75	2.75
4.1.4.2	Extremely friendly	.05-.10	21.4	X		3.25	2.75	2.75
4.1.4.3	Loud, boisterous	.10-.20	56.	X		3.50	2.75	2.75
4.1.4.4	Becomes quiet			X		3.25	2.75	2.50
4.1.4.5	Strangers					2.33	2.00	2.00
4.1.4.5.1	Greets them (self-appointed host)			X		2.75	2.25	2.50
4.1.4.5.2	Introduces self				X	2.50	2.25	2.50
4.1.4.5.3	Reveals personal matters				X	3.00	2.25	2.75
4.1.4.5.4	Discusses personal assets/weakness					3.00	2.25	2.75
4.1.4.6	Insulting, critical				X	2.67	2.00	2.67
4.1.4.7	Amorous [coquettish, getting physical, body language, flirting]		11.9	X		3.00	2.50	2.75
4.1.4.8	Bold			X		3.25	2.50	3.25
4.1.4.9	Talkative	.05-.15 .01, .05		X		3.50	2.50	3.25

Cue Number	CUES	Report. BAC lev.	Obs. Freq. (SIP)	Focus Group		Expert Ratings		
				Mention	Accept	Val.	Rel.	Freq.
4.1.4.10	Uninhibited	.01				3.50	3.00	3.25
4.1.4.11	Convivial, Jovial					3.00	2.50	2.75
4.1.4.12	Rude, Obnoxious		16.7			3.25	2.50	3.00
4.1.4.13	Irrational comments					3.25	2.50	3.25
4.1.4.14	Annoys other customers					3.50	2.75	3.25
4.1.4.15	Long goodbyes					3.00	2.25	2.75
4.1.5	Aggressiveness	.05-.15				3.00	2.33	3.00
4.1.5.1	Shy					2.50	2.00	2.25
4.1.5.2	Argumentative		4.4			3.25	2.75	3.00
4.1.5.3	Pushy, domineering, abusive		.8			3.25	2.75	3.00
4.1.5.4	Sexually agressive		12.3		X	3.00	2.25	2.50
4.1.5.5	Lecturing				X	2.75	2.25	2.50
4.1.5.6	Authoritative				X	2.75	2.00	2.50
4.1.5.7	Use of profanity, foul language		20.2		X	3.25	2.25	2.75
4.1.5.8	Flashes of anger			X		3.00	2.00	2.25
4.1.5.9	Belligerent			X		3.25	2.75	2.75
4.1.5.10	Unreasonable				1	3.25	2.75	2.75
4.1.5.11	Defensive			X		3.25	2.25	2.75
4.1.5.12	Invades personal space			X		3.00	2.25	2.50
4.2	Subjective -- complaints or claims of:							
4.2.1	Nervousness, anxiousness					2.00	1.50	1.25
4.2.2	Mood, claiming to feel particularly good					2.75	2.00	2.25
4.2.3	Confidence					2.50	2.00	2.00
4.2.4	Feelings towards others					2.25	2.00	1.50
4.2.5	Aggressiveness					2.75	2.25	2.25
4.2.6	Wanting to be liked				X	2.00	1.75	2.00
5	Motor							
5.1	Speech							
5.1.1	Slurred	.05-.09	32.5	X		3.50	3.50	3.50
5.1.2	Slow	.10-.20				3.50	3.25	3.00
5.1.3	Overenunciated, difficulty in enunciating, word confusion				X	3.75	3.25	3.25
5.1.4	Volume level changes				1	3.33	3.00	2.67
5.2	Eyes							
5.3	Coordination	.05-.15		X				
5.3.1	Hands/arms					3.50	3.00	3.00
5.3.1.1	Manual dexterity					3.00	2.67	2.67
5.3.1.1.1	Can't sign name				X	3.50	3.00	3.00
5.3.1.1.2	Drops cigarettes	.20				2.75	2.50	2.25
5.3.1.1.3	Unable to pick up change					3.25	3.00	3.00
5.3.1.1.4	Fumbles with cigarettes				1	3.00	2.75	2.50
5.3.1.1.5	Difficulty removing credit cards from wallet/purse				1	3.25	2.75	3.25
5.3.1.1.6	Picks up eating utensils incorrectly			X		2.75	2.00	2.00
5.3.1.2	Makes exaggerated movements	.05-.09	9,9		X	3.00	2.25	2.50
5.3.1.2.1	Slower reflexes				1	4.00	3.00	3.00
5.3.1.2.2	Drops things		7.1			3.25	2.75	3.00
5.3.2	Legs/feet					4.00	3.50	4.50
5.3.2.1	Staggers		23.0			3.75	3.50	3.75
5.3.2.2	Stumbles					3.50	3.25	3.75

Cue Number	CUES	Report. BAC lev.	Obs. Freq. (SIP)	Focus Group		Expert Ratings		
				Mention	Accept	Val.	Rel.	Freq.
5.3.3	Balance					4.00	3.50	4.00
5.3.3.1	Sways	.04-.06	16.7			4.00	3.25	3.75
5.3.3.1.1	Seated					3.50	2.50	2.75
5.3.3.1.2	Standing					4.00	3.75	3.75
5.3.3.1.3	Walking (hands for balance)		5.2			3.75	3.75	3.25
5.3.3.2	Falls					4.00	4.00	3.50
5.3.3.2.1	Seated		4.8			3.25	2.50	3.00
5.3.3.2.2	Standing	.15+				3.50	3.25	3.25
5.3.3.2.3	Walking	.15+				3.50	3.25	3.25
5.3.3.3	Unsteady		9.1		X	3.75	3.25	3.50
5.3.3.4	Weaves		12.7	X		3.75	3.25	3.50
5.3.3.5	Unable to stand, props self up			X		3.50	2.75	2.75
5.3.3.6	Posture - can't sit up straight				X	3.25	2.50	2.25
5.3.3.7	Difficulty sitting down		3.6		1	3.00	2.25	2.25
5.3.3.8	Difficulty getting up		4.4		1	3.50	2.50	2.75
5.4	Nervous system							
5.4.1	Hiccups		3.6		X	3.25	2.25	2.75
5.4.2	Belching				1	3.25	2.25	2.25
5.4.3	Vomiting				4	3.50	2.75	2.50
5.4.4	Seizures, convulsions					3.00	2.50	2.00
5.4.5	Consciousness					4.00	4.00	3.50
5.4.5.1	Asleep	.30		X		3.00	2.75	2.75
5.4.5.2	Unconscious	.30-.40			4	3.25	3.00	2.50
5.4.5.3	Breathing fast				X	2.25	1.50	1.50
5.4.5.4	Breathing slow				X	2.50	1.75	1.75
5.4.5.5	Yawning				X	2.00	1.75	2.00
5.4.5.6	Stupor	.30-.40			1	3.00	2.75	2.75
6	Drinking							
6.1	Ordering							
6.1.1	Amount (doubles)				5	2.75	2.50	2.00
6.1.2	Type (e.g. willing to drink "anything")				X	3.25	2.25	1.75
6.1.3	Timing (ordering before finished)		11.9	X		3.50	2.50	2.50
6.1.4	Complaints about strength					3.50	2.75	12.25
6.1.5	Not interested in food					3.00	2.00	1.75
6.2	Consumption							
6.2.1	Rate (chugging)			X		3.75	3.25	3.00
6.2.2	Manner (gulping)			X		3.75	3.25	3.00
6.2.3	Changes over time			X		3.50	2.50	2.75
6.3	Drinking related activities							
6.3.1	Drinking games				5	2.33	2.00	2.00
6.3.1.1	Suggests them				5	3.00	2.25	2.25
6.3.1.2	Plays them		6.0		5	3.00	2.25	2.25
6.3.2	Buys drinks for others				5	2.67	2.00	2.00
6.3.2.1	Rounds				5	3.25	3.00	2.75
6.3.2.2	For the house				5	3.50	2.50	2.75
6.3.3	Willing to go long distances to drink			X		3.25	2.50	2.75
6.3.4	Encourages others to drink or keep up			X		3.25	2.75	3..00

NOTES

[1] This cue was not mentioned by anyone in the discussion group nor was it included on the list distributed to the participants.

[2]With the exception of "heavy eyelids, sleepy, drowsy", "dizzy", and "nauseous" which several participants agreed could be seen or produced a result which could be seen, the cues under "sensation" were judged too difficult for detection by a casual observer. Most, it was felt, required an individual <u>saying</u> he felt these sensations.

[3]Inconclusive. No consensus of opinion resulted from the discussion.

[4]Participants felt that this symptom appears when an individual is "too far gone" for it to be valid as a cue to impending intoxication.

[5]This cue was not mentioned specifically in the discussion.

APPENDIX B

Cues

Cue code #		
		Appearance
AE-1	Eyes	1. Red, or bleary
AE-2	Eyes	2. Blinking, flitting, unfocused
AE-3	Eyes	3. Lids, heavy
AA-1	Arousal	1. Dull, tired looking
AS-1	Self-rep.	1. Acknowledge intoxication
AS-2	Self-rep.	2. Reports nausea, confusion
AS-3	Self-rep.	3. Reports feels good, confident
AT-1	Temp.	1. Removes clothing
AT-2	Temp.	2. Reddish face, veins visible
AT-3	Temp.	3. Sweat slightly (brow, shirt wet)
		Perception
PD-1	Distance	1. Standing (knocks things over, sets glass down hard, at angle)
PD-2	Distance	2. Moving (bumps into objects or other people--clumsy)
PD-3	Distance	3. Misses objects when reaching
PS-1	Smokers	1. Miss ashtray
PS-2	Smokers	2. Can't light cigarette, fumbles, drops it, drops lighter
PS-3	Smokers	3. Forgets to light cigarette, forgets one is already lit.
PS-4	Smokers	4. Chain smokes
PT-1	Time	1. Slow reaction time, slow responding, slow reflexes
PT-2	Time	2. Decreased percept. time passing
PT-3	Time	3. Long goodbyes
		Cognitive
CC-1	Convers.	1. Rambles, doesn't follow thread, no continuity in talk
CC-2	Convers.	2. Loses train of thought, needs words repeated, seems dense
CC-3	Convers.	3. Repeats stories already told

CA-1	Attention	1.	Poor information processing, poor comprehension
CA-2	Attention	2.	Easily distracted, poor task tracking
CD-1	Decision	1.	Poor ability to choose, evaluate
CD-2	Decision	2.	Careless with money, other things
CE-1	Errors	1.	Mistakes people, things, drinks
CE-2	Errors	2.	Bad memory, confusion, disoriented (time or place)

Emotional

EM-1	Mood	1.	Convivial, jovial, high-spirits
EM-2	Mood	2.	Withdrawn, alone, tranquil, quiet
EM-3	Mood	3.	Very sad, crying, despondent
EM-4	Mood	4.	Nervous, fidgety, anxious arousal
EM-5	Mood	5.	Changes in mood rapidly, inappropriate moods
EA-1	Aggress.	1.	pushy, abusive, argumentative, rude, obnoxious,insulting, critical, hostile, annoying belligerent, unreasonable, defensive
EA-2	Aggress.	2.	Anger flashes
EA-3	Aggress.	3.	Invades personal space, violates social norms
ES-1	Sociabil.	1.	confident, outgoing, loud, boisterous, bold
ES-2	Sociabil.	2.	greets strangers, reveals personality to, and discusses personal life with, strangers
ES-3	Sociabil.	3.	More relaxed, more friendly
EX-1	seXual.	1.	Amorous, flirting, sexually aggressive
EX-2	seXual.	2.	Profane, vulgar, raunchy

Motion (motor behavior)

MM-1	Movement	1.	manual dexterity poor, poor hand/arm coordination, can't sign name, pick up change, credit cards, glass, other objects
MM-2	Movement	2.	sways standing, walking, rocks while seated, unsteady balance, stumbles, falls, weaves
MM-3	Movement	3.	Props self up, leans on things, poor posture

MM-4	Movement	4.	trouble sitting down, standing up, changing position
MS-1	Speech	1.	Slow speaking
MS-2	Speech	2.	Slurred speech, difficulty enunciating
MS-3	Speech	3.	Poor volume control

Drinking style

DC-1	Consump.	1.	Quick drinker, gulps, chugs
DC-2	Consump.	2.	Not interested in food, only drink
DC-3	Consump.	3.	Suggests or plays drink games
DO-1	Ordering	1.	Orders doubles or large drinks
DO-2	Ordering	2.	Orders before finishing previous drink
DO-3	Ordering	3.	Buys for others, buys round for the house
DO-4	Ordering	4.	Encourages others to keep up
DO-5	Ordering	5.	Speaks for the group on orders
DP-1	Plumbing	1.	Frequent trips to restroom
DP-2	Plumbing	2.	Belches, hiccups, vomiting

APPENDIX C

APPENDIX C

INFORMATION FOR OBSERVERS

What is it that we'll be doing?

This is an experimental procedure being conducted in the interest of highway safety by the National Public Services Research Institute in Landover, MD. We would like to know to what extent people are able to accurately estimate alcohol impairment of drinking guests.

Why is it important?

Alcohol use and driver impairment is the single largest threat to safe operation of a motor vehicle. Studies have shown that the majority of people stopped at roadside sobriety checkpoints have just come from, or are going to, a public or private social drinking spot, such as a bar or party.

Currently it is illegal to serve alcoholic beverages to someone who is visibly impaired beyond reasonable doubt. But making that judgment correctly is difficult. It is the purpose of this study to try to identify reliable indicators of impairment. To do this, we will be measuring some motor skills and blood alcohol concentration (BAC). Also, we (you) will be noting behavior change. This is done with the hope that there is a way to educate the public to recognize signs that their guests are becoming drunk. Every state has it's own definition of impairment. Your task is to make judgments as to the impairment levels of drinking guests at a party. Make your judgments on the basis of the behavioral signs of intoxication that are possible for anyone to see.

How is it done?

We have arranged for different groups of people to conduct parties. And you are invited. While the guests drink and enjoy themselves, you will track 5 to 7 drinkers and make impairment estimates every half hour.

<u>You need to be subtle</u>. That is, don't make it obvious that you are watching the drinkers. When people know they are being observed it often interferes with their behavior. This is a little bit like stage fright, or the kind of self-consciousness that many people experience when they stand in front of a video camera. We need to avoid the guests getting the idea that they are "on stage," but we do need to make perceptive observations of their signs of intoxication. We would like you to record your observations at regular half-hour intervals on cards that we will supply (example enclosed). If, while observing, you make an observation that you think is indicative of impairment, note what happened that led to your judgment of impairment.

Each of you will be assigned a group of drinkers to observe during the evening. All drinkers will have numbers that they wear on their shirtfronts so you can identify the people in your observation group. Again, don't let on that you are watching them, but do try to engage them in conversation, or at the very least, keep an eye on them. After four hours of observation, if you are observing six drinkers, you will have made 48 impairment estimates.

While you will be making continuous observations, you will only need to record them briefly at half hour intervals. For example, between 8:30 and 9:00 you may have noticed that number 30 still hasn't changed a bit, 31 looks moderately impaired, was talking loudly, has rolled up his sleeves and opened his shirt, 32 spilled his drink on his lap, bumped into the wall and looks severely impaired. At 9:00, find a quiet spot, like the restroom or outside, and record all your observations for that half-hour period. Prepare your next card with initials, circle your group decade and go make your next round of observations. Try to keep to a regular routine.

Making Impairment Estimates

Because not everyone gets drunk the same way, making estimates of impairment is at best an inexact science. By collecting information from you we want to try to make it a little bit more exact.

Based on what the drinking people do, you need to judge whether they are slightly, moderately or severely impaired.

The meaning of each category differs along a scale of severity of impairment. As a person becomes more alcohol impaired, their reaction time, skills, and judgment all become poorer. One way to think about these impairment categories is in terms of the drinker's ability to operate a car, since good driving requires good judgment, reactions, and motor skills.

- Someone who has been drinking but can be judged to be only slightly impaired is someone whose judgment, reactions and skills are pretty close to normal. For example, such a person is probably not a risk to highway safety.

- Someone who is moderately impaired is someone who has had enough alcohol to have possibly altered their normal skills, reactions, and judgment but maybe not enough to be dangerous. Such people, for example, would be a possible danger out on the roads.

- Someone who is severely impaired is someone who has consumed enough alcohol to have had their reactions, judgments and skills altered enough to be visibly drunk. Such a person would pose a threat to safety.

Incentives for Accuracy

There will be 4 of you making observations. Each of you will be observers at the same three parties. At the conclusion of our data gathering period, we will be able to determine which observers were the most accurate at making impairment estimates. This is because the procedure requires each drinker to report periodically for a breath test that will indicate to us what his/her true Blood Alcohol Concentration (BAC) is at that time. Based on what the actual BAC is, and what skill impairment we find in measured tasks, we will be able to determine which of you observers was the overall most accurate in your half-hourly judgments. If your judgments are correct and you have reported each new intoxication sign in the proper format, it is money for you!

The most accurate estimator during each party will receive a bonus $12 (first place). Second place will receive $6, and third $3. Therefore, it is to your advantage to not only be as accurate as possible, but to work independently of the other observers. Feel free to socialize with the other observers, but don't compare notes and techniques with anyone because you are all competing against each other. The sharpest observer working three parties could add another $36 to their basic $150 earnings. These rewards will be paid about one week after the party, or as soon as we get the results calculated to determine a winner.

Dress and Other Things

Think comfort...with the following stipulation. Be sure that whatever you wear, it has a pocket large enough to fit the enclosed card, and a pencil to make your notes.

If you have allergies to cats, cigarette smoke, or similar things that are inevitable in others' homes and parties, be sure to bring whatever you need to be comfortable.

Review

Mingle and make subtle observations. On each card (a different card each half hour), note the following:

- your initials
- make a judgment for each drinker (slight, moderate or severe impairment)
- what you saw that made you think the drinker changed levels

The last item needs to be noted only when there is a change in your judgment, or if something notable happens.

APPENDIX D

YOUR BAC GUIDE

You may have heard the term "BAC". It refers to Blood Alcohol Concentration, or how much alcohol is in the bloodstream. Police give breath tests to measure BAC to tell if a driver is intoxicated -- too drunk to drive.

If you had a breath tester when you were serving drinks, you could measure BAC and tell whether your guests were too drunk to drive. Even better, you could tell if they were "on the way" to getting drunk and keep them from getting there.

You may not be able to give a breath test, but you can still check a guests BAC, that is:

B Behavior - How They Act.

A Appearance - How They Look.

C Coordination - How They Move.

This booklet gives you the abc's of BAC. It will help you tell when guests have beginning to become impaired by alcohol. That way, even if they don't know "when to say when," you will.

SLIGHT IMPAIRMENT

Any alcohol can affect people. Most people become more relaxed, find it a little easier to talk with others and generally enjoy themselves more. That is one of the main reasons they drink.

At this level, the driving ability of most people will probably be slightly affected. After one or two drinks, they may get a little clumsy or their judgement becomes questionable. Most are not, however, a danger to themselves or others, and it is not illegal for them to drive.

MODERATE IMPAIRMENT

People who are moderately impaired aren't necessarily drunk, but they are definitely on the way. They will show it in their behavior, their appearance, and their coordination. And they show it in their driving too. If that happens, they can be arrested even if the other BAC (the one the breath tests) does not say they are intoxicated.

If you see even one of the following signs, the chances are very good that you are looking at someone who is well on the way to getting drunk. This is the time to start taking precautions (such as slowing down drink service) to see that this drinker does not continue drinking and become "Severely Impaired."

Behavior

How do they act -- toward you and other guests. Look for the following signs:

Loudness -- Loud or somewhat domineering conversation.

Closeness -- Talking right into someone's face.

Expansiveness -- Exaggerated gestures, letting the hands and arms do the talking.

Suggestiveness -- Suggestive language, mild profanity.

Physical Contact -- Hugging, touching, or caressing. Touching, poking, or thumping people while talking to them.

Rudeness -- Lack of inhibition, rudeness, doing things that don't quite fit the company or the occasion.

Withdrawal -- Not speaking to others, going into another room alone.

Of course, for every one of these acts, there is somebody who does it without ever having touched a drop! That's why it helps to see people before they start drinking.

Appearance

When people are moderately impaired they often have a certain look about them.

Warm -- Sweating, face rosy, may loosen clothing (tie off, sleeves rolled up, shoes off)

Red eyed -- Eyes look red, bloodshot, or tired (heavy eyelids).

Rumpled -- Clothes askew, hair mussed.

Silly -- They may have a cute, silly or self-satisfied glow about them.

Reclining -- Unusually relaxed posture, spreading out in chair.

Coordination

People who are moderately impaired may begin to have trouble coordinating movement of their hands, arms, body, or mouth. They start to have troubles with their:

Poor dexterity – Begin to have trouble writing clearly or undoing buttons, picking up change off the counter

Slouching – They may slouch or tend to lean on things when they are talking.

Deliberate speech – They have to make a real effort to speak clearly.

By the Numbers

Any one of these signs points to somebody who is moderately impaired. But, if you count six or more of these signs in the same person, they are more than "moderately" impaired – they are.....

SEVERELY IMPAIRED

This means drunk. Anyone who drives when they are at this level is breaking the law and can be held responsible if there is an accident and somebody gets hurt. In many states, the same thing is true even for people who serve alcohol to the intoxicated person.

A real falling-down drunk is obvious to anyone. But, signs of severe impairment can be hard to spot in the early stages. And too, there are those people who can get completely bombed without showing it. Here are the signs of severe impairment you are most likely to see. Any one of these signs means someone who is very likely to be drunk. Many of the signs are the same as those shown when people are under the influence, but turned up a notch or two.

Behavior

Social Disregard – Letting go completely, uninhibited (e.g., dancing without a partner, looking through cabinets, making sexual advances, urinating outdoors).

Hostility – Becomes rude or hostile. Pushing, cursing, shouting.

Profanity – Lewd, strong profanity.

Confusion – Forgetful, completely addled. They forget what they have been talking about, what someone else just said, or the fact that they just lit up a cigarette when they had another one burning.

Appearance

Sloppy – Clothing rumpled or askew, hair mussed.

Coordination

Fumbling – Shaky hands, fumbling with objects (e.g. pencils, cigarettes, lighters); writing becomes a scrawl.

Stumbling – Stumbling, using hands as outriggers to keep from falling; bumps into people.

Poor perception – Misjudges distance or depths. Sets a drink down hard on the table or on the edge of the table. Misses ashtray, toilet, or other targets.

Slurred Speech – Speech is slurred, and even incoherent.

SUMMARY

MODERATELY IMPAIRED	SEVERELY IMPAIRED
Behavior	
Loudness	Social disregard
Closeness	Hostility
Expansiveness	Profanity
Suggestiveness	Confusion
Physical contact	
Rudeness	
Withdrawal	
Appearance	
Warm	Sloppy
Red eyed	
Rumpled	
Silly (smug)	
Reclining	
Coordination	
Poor dexterity	Fumbling
Slouching	Stumbling
Deliberate speech	Poor perception
	Slurred speech

APPENDIX E

APPENDIX E

SCORING PROCEDURE FOR FIELD SOBRIETY MEASUREMENT

Elements of a gaze nystagmus test

Test instrument is pen or pencil, hold slightly above mid-eye plane

6 points to score.

1. smooth tracking from center of gaze to periphery.
   (slightly noticeable discontinuity or jerky movements: score 1 point)
2. hold at periphery
   (failure to hold steady, jerky movements score 1 point)
3. hold at 45 degrees (same criterion: score 1 point)

4-6. same other eye (same criteria: score 3 points)

Elements of 1 leg stand test

30 second stand with 1 leg 4 to 6 inches above floor (toe up)

3 points to score

1. hopping
2. arms out for balance
3. foot touches ground

APPENDIX F

APPENDIX F

SCRIPT FOR VIDEO:

SIGNS OF ALCOHOL IMPAIRMENT

Over 50% of highway fatalities that occur in this country involve alcohol. In real numbers that equals over 25,000 highway deaths each year. And, each year, another 7 to 800,000 auto injuries involve alcohol use by a driver. Studies have revealed that over half of all drunks found behind the wheel of a car were coming from a private party or a bar. This is important because it means that the majority of drunk driving happens at a time when another person might have stepped in and prevented it.

People who serve drinks to others, whether as professional servers...

or at parties given in their own home, need to keep an eye on the people they are serving.

They should judge just how sober a drinker is before letting him have another drink or letting him out onto the road. And they need to ask themselves: "would I want any members of my family to have to share the road with that guy?"

Most states have laws holding professional servers responsible for the damage done by drunk patrons,

and many states even have a way to hold party hosts responsible for damage done by their drunk guests.

The laws in these cases generally hold people partially responsible if they continue to serve someone who is visibly intoxicated.

Most people understand that they have a responsibility to their guests and they're speaking up and cutting people off before they become too drunk to drive.

But in order to keep drunk guests from driving, people first have to know how to spot someone who is becoming impaired by alcohol.

The purpose of this video is to help you spot the early warning signs of alcohol impairment.

[How Drunk is Drunk?]

First, in order to spot people who are becoming drunk, we need to know just exactly what "drunk" means. How drunk is drunk?

The best way to answer this question is to know how much alcohol is in the bloodstream. This measurement is known as the "Blood Alcohol Concentration," or "BAC." BAC is the measurement used by the courts and police to determine if someone can legally be considered drunk.

There is wide agreement that a person who reaches a BAC of 0.10% [read as: point one o' percent] is severely impaired by alcohol. At this BAC level drivers can be legally considered to be intoxicated.

Many states feel that 0.10% is still too high, and in those states the legal level of intoxication begins at a BAC of 0.08% [point o' eight percent].
Drivers with a BAC between 0.04% and 0.08% can be considered "moderately impaired." In many states drivers who are at this level and are stopped by police can be charged with driving under the influence of alcohol if there is evidence that the alcohol in their system has impaired their ability to drive.

Drivers with a BAC below 0.04% are considered to be "slightly impaired." The driving of drinkers who are at this level has probably been somewhat impaired, though not so much they can <u>legally</u> be considered impaired.

In order to prevent our guests from becoming unsafe drivers, it's important that we try to recognize not just the signs of "severe" impairment but also those of "moderate" impairment, so that we can start slowing down service before a guest is too far gone to be reasonable.

[Using Behavior, Appearance, Coordination to Figure Impairment Levels]

If you had a breath tester you could measure your guest's BAC to tell if they were too drunk to drive.

Better yet, you could tell if they were on the way to getting drunk and you could cut them off before they actually got there.

Unfortunately most hosts don't have a breath tester, so they can't use the Blood Alcohol Concentration to judge their guests condition. Still, there's another kind of BAC you <u>can</u> use. Hosts can get a good idea of how far along a drinker is by watching their:

<u>Behavior</u>, (how they act toward others)

their <u>Appearance</u>, (how they look)

and their <u>Coordination</u>, (how they move and talk).

These three types of cues appear at each level of impairment. Knowing what they mean can be a big help when it comes to judging how much your guests have had to drink.

One thing that needs to be clear is that there are no hard rules for translating cues into levels of intoxication.

Every drinker is different. But even though there are no hard rules, there are general patterns.

Any alcohol can affect people. After a couple of drinks most people become more relaxed and find it easier to talk to others. This is one of the reasons people drink in the first place. Drivers may also begin to lose their ability to use good judgement. They may become a little clumsier.

While drivers with this much alcohol in their systems have been slightly impaired by alcohol, they are not generally considered dangerous and they are not legally considered to be drunk.

Still, hosts should be aware of guests who are at this level because they may be about to move to the next level...

"Moderate Impairment."

[Behavior when Moderately Impaired]

Social situations, such as parties, provide a good atmosphere in which to judge changes in social behavior.

We will show and describe signs of people who are moderately impaired. Any one of these signs is a good indication that someone is pretty far along.
When a group of friends get together to drink, one of the most obvious changes is in the noise level.
Loud conversation is just about the most reliable of all the changes that take place after people start drinking.

Everyone reacts differently to alcohol, but generally when BAC rises above .04%, the distance between people locked in conversation decreases.
There is considerably more touching, hugging, caressing. Naturally, this takes different directions depending on the drinker, but overall, people tend to get closer and more familiar with each other.

Even strangers.

[Natural audio: "Say, did anyone ever tell you you've got a really dynamite..."]

In general, a person who is Moderately Impaired
is less concerned about adhering to normal rules of social behavior.

They may start using more profanity in their conversations.

[Natural audio: "For crissakes, I can't believe it!"]

Hand and arm gestures used in making a dramatic point are often wider, more bold.

Drinkers may show inappropriate moods, laughing at others misfortunes,

[Natural audio: "Let me go get a rag to clean that up." "No that's OK, Larry likes it like that, Hey Larry you're all wet!"]

They might be more inclined to make comments or jokes that others might consider crude or forward.

Natural audio:" There is that better? Yeah, but it's kinda cold and wet and why don't you just sit and warm it up a little bit?]

Some drinkers may be overly negative when those around them are being positive.

A good way to judge changes in the sociability of drinkers is to make note of how they're acting when they first arrive.

Talk to them regularly. Get a sense of how much they've changed since beginning to drink.

Not everyone will arrive at a party "stone/cold" sober. But having a clear idea of someone's behavior in the beginning will be a helpful reference for your later judgements about impairment.

[Appearance when Moderately Impaired]

Since alcohol moves very quickly into the brain, the earliest signs of alcohol-impairment are often caused by changes in the way that the brain controls the flow of blood in the body.

When alcohol relaxes the brain's control of blood vessels on the skin surface, the vessels carry more blood through them.

This can be obvious through the reddening of the skin when a person drinks.

The eyes on some people may look bloodshot.

When more blood flows near the surface of the skin, it brings heat with it.

When the temperature sensors in the skin detect more warmth, the person may feel as though he is too warm.

And, naturally, when people feel too warm, they will often loosen or remove clothing.

Sweat may begin to bead on the brow.

You often will hear somebody say that they feel warm.

[Natural audio: "You know, it is getting kind of hot in here, Hey Nancy! how 'bout opening a window."]

When people reach the "Moderate Impairment" stage, details of appearance, such as clothing and hair, may seem to be a little bit less orderly too.

These are usually just about the first signs that you'll see that someone is moderately impaired.

These changes begin to occur at around the same time that people begin to look more relaxed; they may seem to physically loosen up.

Eyelids may begin to drop slightly.

Often a self-satisfied, glow or sparkle--a look of smug silliness--may replace a tighter, more controlled appearance.

[Coordination when Moderately Impaired]

When we refer to "coordination" we mean the way someone moves, the amount of control they have over their hands, arms, feet, legs, facial muscles, mouth, and tongue.

At the "Moderately Impaired" stage, very slight changes in walking, speech, or balance begin to be noticeable.

Some people may begin to lean against walls or tables for support--a little help for sagging muscle strength.

If someone is doing anything that requires fine hand coordination, they'll do it a little sloppier or less controlled.

The earliest changes in speech could possibly begin at this level. While the speech may not be slurred yet, you may find the speaker working a little bit harder to control the way things get said.

[Natural audio: "I know you've got a cigarette machine in here somewhere but I'll be damned if I can find it".]

What you've just witnessed are signs that guests are "Moderately Impaired" by alcohol. They can be viewed as early warning signs that someone is on the way to "Severe Impairment".

The signs that a person has crossed the line from "Moderate to "Severe" impairment are not always easy to pick out, but there are a few things to look for.

The first thing to realize is that the signs of "Moderate Impairment" don't go away when a person becomes "Severely Impaired."

Many of the earlier signs of impairment will probably still be present, but others will show up too. Any one of these signs points to someone who is very likely to be at the "Severely Impaired" level.

One way of determining when someone has crossed the line is to count the number of cues they're exhibiting. When the number of "Moderate" cues reaches 6, any 6, it's probably safe to assume that the drinker you're watching has crossed the line to "Severe" Impairment.

At the very least, someone who shows 6 or more signs of moderate impairment needs a whole lot of watching.
Another way to tell whether someone has crossed the line is to look for changes in the intensity of cues.

[Behavior when Severely Impaired]

For example, the disregard for normal rules of social behavior that was beginning to be apparent when the drinker was "Moderately Impaired" may become more intense.

Closeness and touching may have moved on to passionate embracing, caressing, and French-kissing.

The exaggerated gestures of an individual who was Moderately Impaired may have grown even more exaggerated through dancing and other forms of emotional expression.

People seem freer and looser.

With some drinkers, the disregard for rules of behavior and for the feelings of others takes an uglier turn.

There may be a shift to more hostility in arguments, pushy or rude exchanges, urinating in public, even possibly stealing.

Some people may become extremely outgoing, for instance a Severely Impaired patron in a tavern may order drinks for others near him, or might encourage others to keep up with his drinking.

[Natural audio: "What Benny needs is another drink, Hey Nancy!]

Others may become unusually quiet and withdrawn.

Smokers--distracted by conversation--may smoke more, or have two cigarettes going at the same time.

It may take someone longer to make decisions.

People may make mental errors, such as forgetting where they put something.

[Appearance when Severely Impaired]

With appearance too, most of the signs of Moderate Impairment found earlier may have climbed to new levels.

For example, the red flushing of the face that could have begun much earlier progresses to a much deeper degree after the BAC is above 0.08%. Not everyone flushes in the face of alcohol, but for those who do, the change can be dramatic.

The eyes of some may be not just red, but bleary looking--watery and congested.

Look for rumpled clothing, hair that is more mussed.

Unconventional postures may also occur, such as laying down with the feet propped up on furniture, or stretching out on the floor.

[Coordination when Severely Impaired]

As BAC gets higher and higher, the effects of alcohol will become clearest in the drinkers coordination... or lack of it.

It's still not easy to spot the coordination cues in the early stages when drinkers reach a BAC of around 0.08% and cross the line to Severe Impairment. One reason is that unlike

behavior cues (which are common in a party situation), and

appearance cues (which are always right there to see),

the coordination cues come and go. There isn't any question that the average person at a BAC of .08% has lost some coordination. But, it won't always be obvious.

If you look carefully though you may see a drinker who sets a drink down on the table too hard, or on edge, or spills a little.

People who are standing may begin to sway slightly.

The muscles of the face may fall into a more comfortable sag between conversations--

the person may look tired.

Expect a loss of manual dexterity too. If you see someone fumbling with a pencil, a cigarette lighter, or some another object, that should be a tip off.

Poor control of balance may cause a misstep when people get up or try to walk. When this happens, their arms will generally come out as they try to restore balance.

The path a drunk walks from one point to another can also be a clue,

as is putting out a hand to feel for a nearby wall or chair.

Walking past another person may result in a minor collision of bodies.

As people get drunker and drunker and their nervous systems lose more and more control, they will begin to look more like the "typical" drunks that everyone knows from the TV and movies.
This is someone who stumbles, drools, slurs, bumps, or falls. Those kinds of coordination cues are a world beyond just drunk, and people who serve alcohol need to be able to recognize the effects of alcohol long before the drinker gets to this point.

By searching for cues earlier on you may be able to nip a problem in the bud, so that you don't end up having to deal with--and be responsible for--a full blown, pain-in-the-neck drunk.

[Summary]

We've talked about how you can judge the impairment level of drinkers with reasonable accuracy when you know what to look for. This video guide was intended to help you identify people who are drinking and may be getting drunk.

The signs of impairment shown here are based on the average responses of a large number of drinkers.

Any individual could be different. For that reason, the information here is meant to supplement your own judgment about impairment, not replace it.

If you are concerned about the drunk driving problem, and you serve alcohol in your home...

or where you work, you owe it to your family, your friends and your community, to take the time to learn the signs of alcohol impairment.

You might want to think about the cues to impairment as you would a red traffic light up ahead, and the drinker as a motor vehicle that is hurtling out of control.

When <u>you</u> serve the booze, just as surely as when <u>you</u> drive a car, <u>you</u> need to put on the brakes.

We <u>all</u> need to take part in trying to keep drunks off the highway.